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FINAL

ENVIRONMENTAL INFORMATION VOLUME SOUTHERN COMPANY SERVICES SELECTIVE CATALYTIC REDUCTION PROJECT AT PLANT CRIST PENSACOLA, FLORIDA

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1.0 INTRODUCTION

This section (a) provides a backdrop to implementation of the project; (b) describes the organization of this report; and (c) summarizes potential environmental, health, safety, and socioeconomic impacts of the project.

1.1 Background

In February 1988, the U.S. Department of Energy (DOE) issued a Program Opportunity Notice to solicit proposals for financial assistance required to conduct cost-shared Innovative Clean Coal Technology (ICCT) projects. The primary objective of the ICCT program is to fund projects that have the potential for demonstrating cost-effective, commercialization-capable technologies that can achieve significant reductions in sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions from coal-burning electric power plants.

One of the projects selected for entitlement to ICCT funding is the use of selective catalytic reduction (SCR) as a means to reduce NO_x emissions at Plant Crist near Pensacola, Florida. This project is offered for demonstration by Southern Company Services, Inc. (SCS). SCS is the engineering services branch of the Southern electric system, which consists of SCS and five operating companies serving a four-state area (Alabama, Georgia, Mississippi, and Florida).

This document is a self-contained Environmental Information Volume (EIV) for the Plant Crist SCR project that has been prepared by SCS for the DOE to facilitate DOE's compliance with the National Environmental Policy Act of 1969 (NEPA). This document was prepared in accordance with the Council on Environmental Quality's NEPA regulations at 40 CFR Parts 1500-1508; the DOE's guidelines for compliance with NEPA (initially published in the Federal Register on March 28, 1980, and amended in 1982, 1983, and 1987); the ICCT Program Opportunity Notice (February 22, 1988); and the Environmental Guidance Manual for ICCT Program Selectees, DOE Pittsburgh Energy Technology Center (October 1988).

This EIV is organized as follows: Section 1 is the introduction; Section 2 describes the SCR demonstration project; and Section 3 describes environmental, health, safety, and socioeconomic aspects of the existing power plant. The impacts of the project in these areas are identified and evaluated in Section 4; while Section 5 discusses the federal, state, and local regulatory implications of conducting the demonstration project. Section 6 presents the qualifications of the individuals who prepared this document. Section 7 contains references and contacts used to prepare this document.

1.2 Summary of Impacts

In summary, the proposed SCR project will have no significant impacts on the existing environment.

Although SCR is a dry process, it will result in an inconsequential increase in the generation of wastewater from quarterly washing of the air preheaters associated with the application of the SCR process. In addition, ammonium bisulfate (which may be created as a result of the presence in the flue gas of unreacted ammonia) may be collected in the fly ash. Potential water impacts from ammonium bisulfate distribution in the ash pond and landfill are not expected because of the low estimated rate of formation of the material. Because less than 1 percent of the plant's total flue gas volume will be routed through the catalyst units, there is limited potential to affect, either positively or negatively, the character of the emissions. An insignificant reduction in total plant NO_x emissions is anticipated.

Because the process equipment will be located on previously disturbed land, no additional land will be disturbed by the project. Thus, there should be no ecological (e.g., habitat destruction), land use, or archaeological impacts from this project. The minor construction and operating personnel requirements will result in a slight positive economic impact to the community with no countervailing socioeconomic impacts.

Three potential issues associated with the SCR process were examined to determine their likelihood of occurrence and the level of risk they could pose to human health. The first issue relates to the potential for creation of airborne carcinogenic precursors as a result of SCR utilization. However, based upon a previously conducted risk assessment, as well as site-specific equilibrium calculations, worst-case risks to human health are very minimal and fall well within generally-recognized regulatory limits of acceptable carcinogenic risks. The remaining two health and safety issues relate to: (a) ammonia use and storage and (b) handling of spent catalysts. With respect to the former issue, appropriate fail-safe systems will be designed and implemented to ensure that the risk of an ammonia release is minimized. Pertinent plant employees will receive additional chemical-specific training. With respect to catalyst handling, there should be minimal opportunity for potential employee exposure since there is not expected to be frequent change-outs or long-term storage on site.

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2.0 THE PROPOSED ACTION AND ITS ALTERNATIVES

This section provides (a) an overview of the technology of the project and how it will be implemented at Plant Crist; (b) a brief orientation to the plant's current operations; (c) a summary of project resource requirements and environmental effects; and (d) an assessment of why this site was chosen.

2.1 The Proposed Action

SCS proposes to demonstrate the use of selective catalytic reduction (SCR) as a means to reduce the emissions of oxides of nitrogen (NO_x) from pulverized coal utility boilers.

SCR is an NO_x emission control technique in which a stream of ammonia (NH_3) diluted with air is injected into boiler flue gas, usually downstream from the boiler's economizer section. The flue gas containing NH_3 and NO_x then passes through a reaction chamber which contains a catalyst. Under the influence of the catalyst, NH_3 and NO_x react selectively to produce nitrogen (N_2) and water vapor (H_2O).

Commercial-scale SCR was first developed in Japan for natural gas and oil-firing, but was later applied to low-sulfur coal-fired boilers. Through these developments, considerable commercial experience is available in Japan for both SCR catalyst technology and SCR process engineering (Ref. 1). However, because of differences in fuel chemistry and operational patterns, Japanese experience is not directly applicable to U.S. medium- to high-sulfur, coal-fired boilers.

The proposed demonstration project will evaluate the economic and environmental impacts of applying the SCR technology to a medium- to high-sulfur bituminous coal-fired power plant. A small portion of the flue gas from two units (Units 5 and 6) at Gulf Power's Plant Crist will be treated and monitored to evaluate the SCR technology. The project design and construction phase will take approximately two years, and the project startup and operation will last approximately two years. After the demonstration project is completed, the test facilities will be removed after the testing period unless testing of other catalysts is anticipated.

2.1.1 Site Description

2.1.1.1 Site Location

The proposed project site is at Plant Crist, located about nine miles north of downtown Pensacola, Florida. The plant is located on the west bank of the Escambia River about five river miles from where the Escambia River empties into Escambia Bay, an arm of Pensacola Bay. The coordinates of the plant are 30°34' N Latitude and 87°13' W Longitude. Highway access from U.S. Highway 90 (a major west-east thoroughfare paralleling Interstate 10) is as follows: approximately one mile east of the intersection of U.S. Highway 29 and U.S. Highway 90 go north on State Road 759 (Chemstrand Road) for approximately one mile. At this point turn east onto Ten-Mile Road. After one mile, turn left on a private paved road leading to the plant. Figure 2-1 shows the general location of the plant site.

The plant occupies 680 acres of land that had been a fishing camp prior to construction of the first units of the plant in 1945. The land adjacent to Plant Crist is presently undeveloped or utilized for industrial or institutional purposes. To the east and north is a large marshy area of undeveloped wetlands. The residential areas closest to the site of the SCR project are about one mile to the west. A major industrial facility in the proximity of Plant Crist is Monsanto Fibers and Intermediates Company. The Monsanto Plant, which began operation in 1953, is located approximately 2.5 miles upstream of Plant Crist on the Escambia River. The campus of the University of West Florida borders the plant on the south. The Scenic Hills Sewage Treatment Plant, operated by the Escambia County Utilities Authority, is located adjacent to Plant Crist along the southeast property line. About one-third of the 680-acre plant is in an undisturbed condition (i.e., wooded).

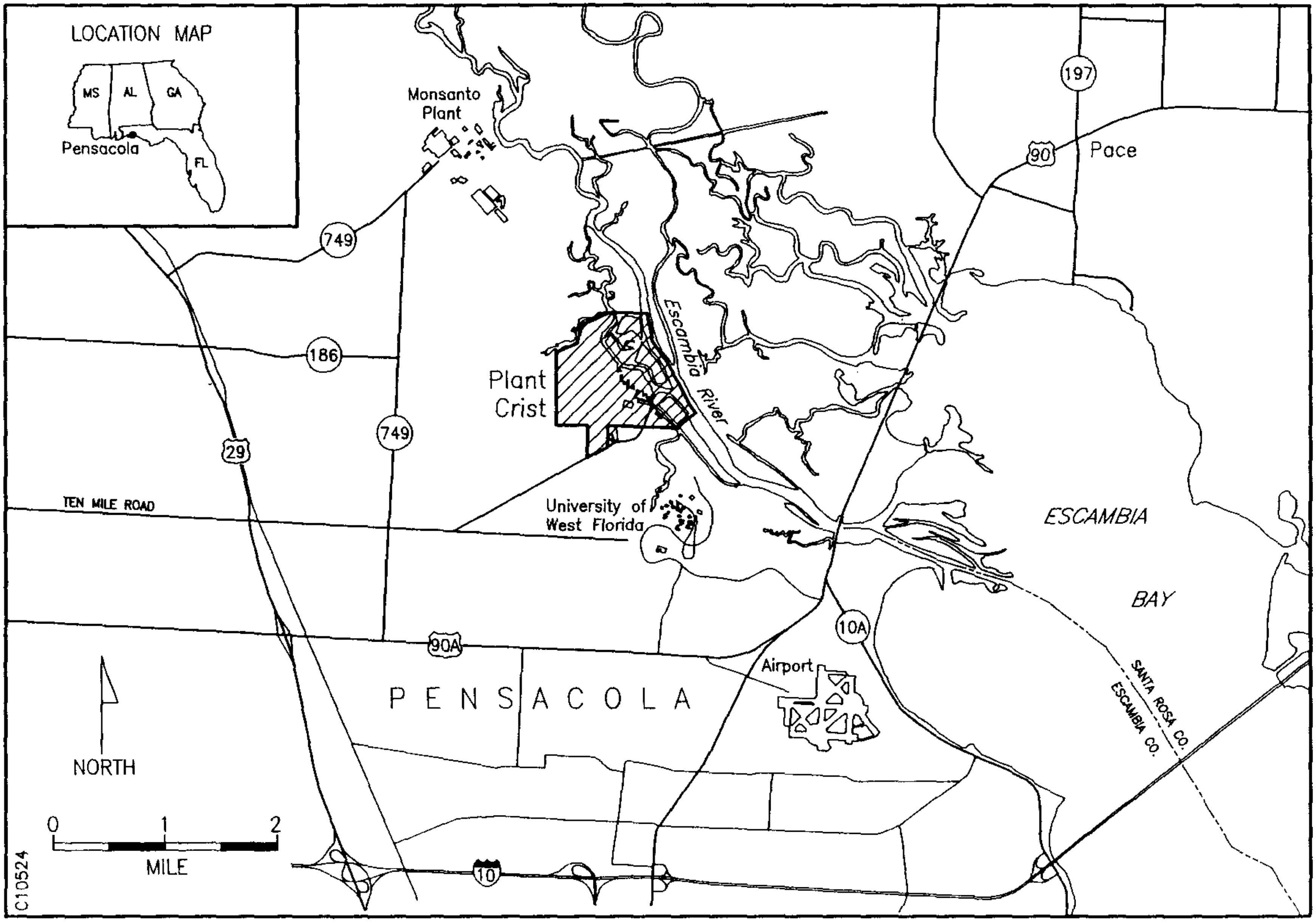

Figure 2-1. General Location of the Plant Site

2.1.1.2 Existing Plant Operation

Figure 2-2 shows a general layout of Plant Crist, including the main plant, the coal storage area, and parts of the current ash disposal pond, and the old ash disposal area on Governors Island.

The plant consists of seven operating units with a gross electrical generating capacity of 1,096 MW. Units 1 through 3 have the capability of burning gas and/or oil; Units 4 through 7 can burn coal and/or gas. Typical of most fossil-fuel fired power plants, Units 1 through 7 were constructed side-by-side. Figure 2-3 shows a more detailed layout of the main plant area and the proposed site of the SCR project. As can be seen, the three gas-fired units (Units 1 though 3) and coal-fired Units 4 and 5 share a common stack while Units 6 and 7 share a common stack. The coal storage area is north of the boiler stacks (Ref. 2).

Coal Supplies

During the past four years, coal consumption at Plant Crist has averaged 2 million tons per year (Mty), varying from 1.6 to 2.3 Mty. The two units that will be used in the SCR demonstration project, Units 5 and 6, consumed an average of 175,000 and 635,000 tons per year, respectively, during the past three years. From mines in West Virginia and southern Illinois, the coal is shipped by 1500-ton barges down the Mississippi River and through the intercoastal waterway to the plant site where the coal is unloaded using either of two unloading systems (Ref. 2).

Solid Wastes

In burning coal for power generation, the primary solid waste products produced are bottom ash and fly ash. At Plant Crist, the bottom ash (collected at the bottom of each boiler) and the fly ash (collected in electrostatic precipitators) are currently collected separately. Bottom ash is sluiced to dewatering bins where it is dewatered and then transported to an

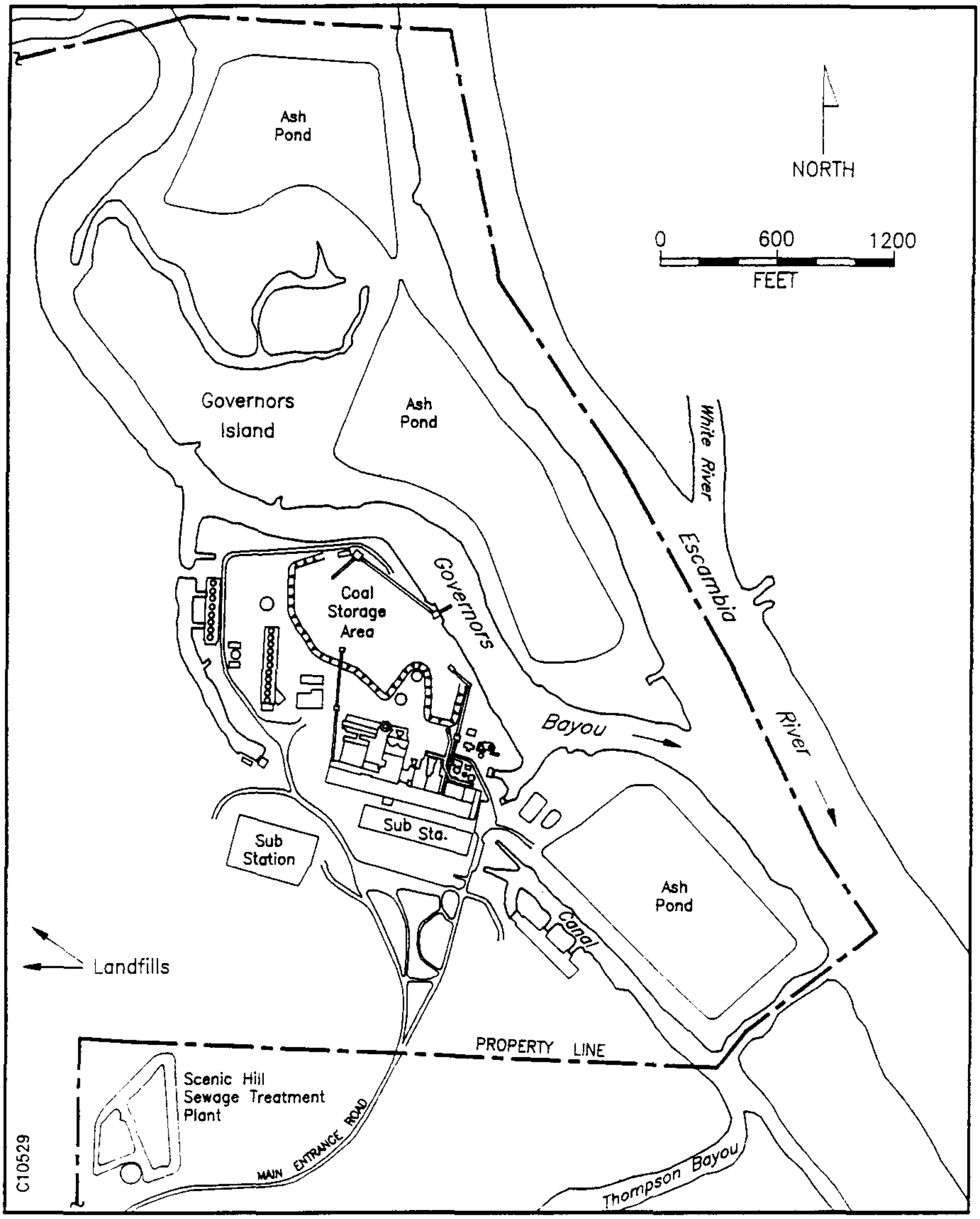

Figure 2-2. General Layout of Plant Crist

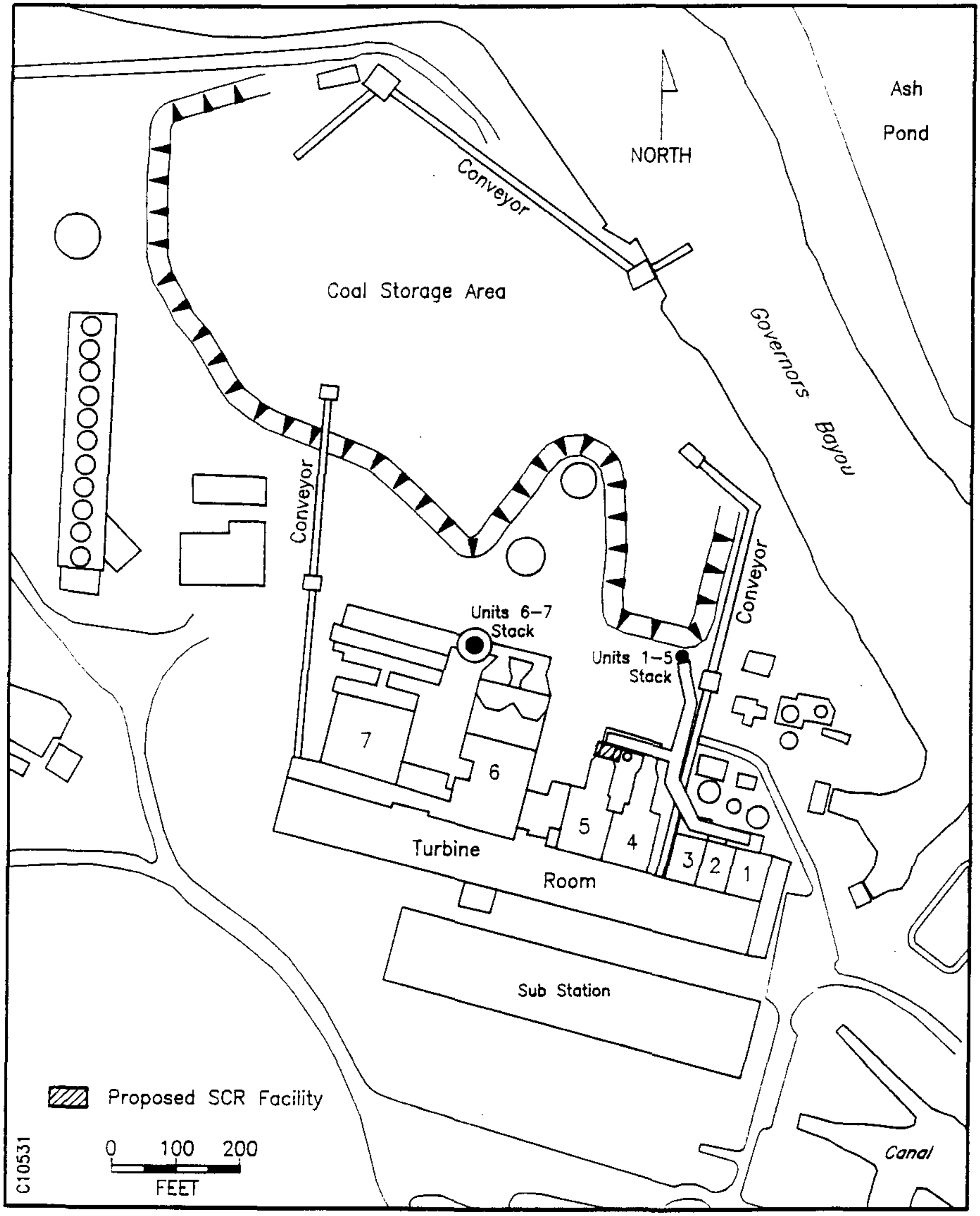

Figure 2-3. Detailed Layout of the Main Plant Area and the Proposed Site of the SCR Project

on-site permitted landfill. The fly ash is collected dry and conveyed pneumatically to storage silos. Some of the fly ash is sold as a by-product, while the remainder is disposed of in the on-site permitted landfill.

Water Use

Plant Crist is permitted to withdraw an average of 248 million gallons per day (Mgd) of water of which 2.2 Mgd is from groundwater sources. The remainder is from the Escambia River. The plant utilizes large volumes of cooling water drawn from three locations along Governor's Bayou. Cooling water for Units 1 through 5 are passed through a mechanical draft cooling tower that serves as a "helper" tower to reduce once-through cooling temperature water. Units 6 and 7 are operated on a closed cycle system using mechanical draft cooling towers with makeup drawn from Governor's Bayou. Water is also withdrawn for use in bottom ash sluice, boiler and air preheater wash water, turbine cooling, hydrogen cooling, and auxiliary equipment cooling and sealing. Water withdrawn from groundwater supplies is used for fire water system, drinking water, boiler water and boiler cleaning, condenser cooling, and boiler seal water.

Wastewater

Bottom ash sluice and low volume plant wastes are allowed to settle in an ash pond. Prior to leaving the ash pond, the effluent is neutralized. A floating skimmer prevents any unsettled ash from leaving the pond.

Units 4 and 5 boilers are acid-washed once every five years; and Units 6 and 7 are acid-washed once every eighteen months. The boiler cleaning waste is pumped to a rubber-lined surface impoundment after three pretreatment steps: copper removal, iron removal, and alkaline post boil. The wastewater is treated as necessary to reduce pollutant levels below applicable standards. After the metals have precipitated out, the treated wastewater is pumped to the ash pond. Sanitary wastes are treated in a package plant before discharge. All discharges are monitored under state and federal permit provisions (Ref. 3).

2.1.2 Engineering Description of Proposed Action

In summary, this proposed project will involve the demonstration of SCR by treating a small portion of the flue gas from two of the seven units at Plant Crist. A slipstream of the flue gas from Units 5 (75 MW tangential-fired) or 6 (320 MW wall-fired) will be extracted from existing duct work at one of three locations and routed through the three large SCR reactor units, each with a capacity of 5000 standard cubic feet per minute (scfm). There will also be six small reactors, each with a capacity of 100 scfm. The three sampling locations provide flexibility in obtaining flue gas with different levels of particulate and nitrogen oxides. Unit 5, for example, has a hot electrostatic precipitator (ESP) so flue gas will be sampled before and after the ESP to get high- and low-particulate loadings. Only high particulate information can be secured from Unit 6, but since it is a large wall-fired unit, it has higher baseline NO_x emissions from which to assess reduction efficiencies.

When all of the large and small reactors are in operation, the total equivalent capacity of the proposed SCR project is 7.8 MW. This is equivalent to 10 percent of the installed capacity of Unit 5; 2.4 percent of Unit 6; and, in total, less than 1 percent of the entire plant's flue gas volume. The fact that the proposed SCR project will not affect more than 1 percent of the flue gas from Plant Crist is an important consideration when evaluating impacts of the project.

Ammonia will be injected into the flue gas (before the gas enters the SCR reactors) to facilitate the NO_x reduction process. The NO_x removal efficiency and other parameters will be measured before the treated gas is discharged into the main flue gas duct for particulate removal and discharge to the atmosphere.

Engineering will begin in November 1989 with construction commencing in May 1990. One year later, in May 1991, the plant will start up with the project testing and evaluation occurring over a two-year period. The equipment will be dismantled and the project completed by mid-1993. A more detailed description of the project scheduling, project configuration, project resource requirements and residuals, and potential environmental receptors follows in Sections 2.1.2.1 through 2.1.2.4 below.

2.1.2.1 Description of Project Phases

The demonstration project consists of four phases. Phase 0, which covers the first ten months, includes activities leading up to project award. These activities include NEPA compliance, refinement of project costs, selection of catalyst suppliers, review of technical design bases, and finalization of financial and contractual arrangements.

Phase I, which covers a six-month period, includes completion of project permitting, and preliminary engineering design. As described in Section 5, the permitting is anticipated to be straightforward based upon preliminary discussions with permit agency staff and the minimal effects of this project on emissions, effluents, and waste discharges. During Phase I, an Environmental Monitoring Plan (EMP) will also be developed. The EMP will specify what parameters should be measured during SCR operation and how this measurement can be accomplished. Phase I will also address some preliminary engineering issues that must be resolved before initiation of detailed design. These include development of a piping and instrumentation drawing (P&ID) and design decisions concerning selection of certain types of equipment.

Phase II, which includes detailed design engineering, project construction, and the initial start up and shakedown testing of the facility, occurs over a 18-month period. Phase III includes the operation and testing and the dismantling of the project facility. The actual operation and evaluation of the SCR process occurs over a twenty-four month period. The duration of the entire project (Phase 0 through dismantling) is 58 months, or almost five years.

2.1.2.2 Description of Project Configuration and Installation

Prior to the submission of SCS' proposal for this project, a preliminary design basis was developed. Table 2-1 is a summary of this preliminary design basis. The facility configuration and flue gas flow path, depicted in Figure 2-4, are described in the following paragraphs.

The prototype SCR facility will have the capability of extracting a representative flue gas sample from any of three main power plant duct locations at Plant Crist:

- Unit 5 prior to hot-side electrostatic precipitator (i.e., Unit 5 high dust);
- Unit 5 after hot ESP (Unit 5 low dust); and
- Unit 6 prior to air heater/cold ESP (Unit 6 high dust).

Since Unit 5 at Plant Crist is a 75 MW tangential-fired boiler and Unit 6 is a 320 MW wall-fired boiler, these three sampling locations provide flexibility to acquire flue gas with different levels of particulate and inlet NO_x. The same coal will be burned in each boiler, thereby maintaining constant fuel sulfur and fly ash compositions.

The flue gas extraction will be accomplished by inserting a 42-inch diameter gas sampling scoop into the ductwork at the appropriate location. The sampled flue gas will be routed to the prototype SCR facility via individual ducts. These supply ducts will intersect just prior to the SCR facility.

TABLE 2-1. DESIGN CRITERIA FOR SCS PROTOTYPE SCR DEMONSTRATION PROJECT

Site:	Gulf Power Company, Plant Crist, Units 5 and 6, Pensacola, Florida.	
Size:	5,000 scfm for each SCR/APH train. 100 scfm for each small catalyst test unit.	
Reactor Design Parameters:		
	Large Reactor	Small Reactor
--linear velocity	6.5 std ft/sec (14.6 actual ft/sec)	6.5 std ft/sec (14.6 actual ft/sec)
--space velocity	2,540 hr^{-1}	2,450 hr^{-1}
--cross sectional area	12 ft^2	0.25 ft^2
--catalyst elements	6 x 8 elements each 150 mm x 150 mm	1 element at 150 mm x 150 mm
--dimensions	3 ft x 4 ft	0.5 ft x 0.5 ft
--catalyst displaced volume	118 ft^3	2.25 ft^3
--catalyst density	0.6 g/cm^3	0.6 g/cm^3
--catalyst height	9.8 ft (3 catalyst layers with provision for a 4th layer)	9.8 ft (3 catalyst layers with provision for a 4th layer)
--reactor height	50 ft	50 ft
Minimum Gas Velocity in All Ducts:	60 feet/second	
Flue Gas Pressure at SCR Inlet/Outlet:	-20 inches wg/-10 inches wg. SP - 10" wg	
Inlet Temperature to SCR:	700°F for design. Controlled by in-line heaters for each reactor train.	
Inlet Dust Loading:	Ranges from 5980 to 8090 mg/Nm^3 under high dust conditions. Reactor to be designed initially for high dust conditions.	
Desired deNO_x Capability:	Achieve 100 ppm NO_x in SCR outlet (corrected to 3% excess O_2) under all conditions.	

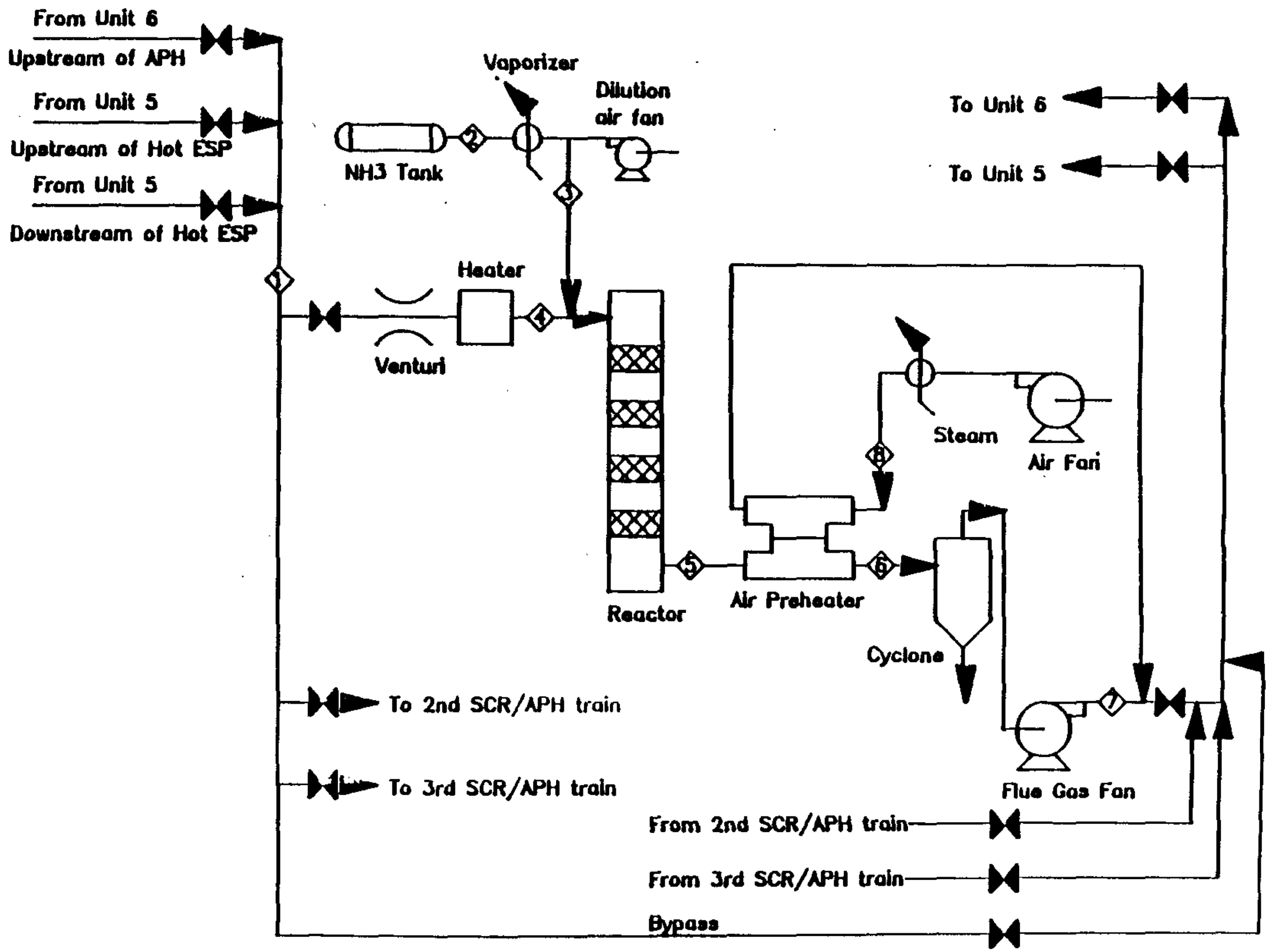

Figure 2-4. Simplified Process Flow Diagram for Prototype SCR Plant

Flue gas flow through each reactor will be monitored by an in-line, full-flow venturi placed downstream of electric in-duct heaters. These in-duct heaters are included to allow the inlet gas temperature to be controlled to a specified level. Thus, the venturi will be measuring gas flow under reasonably constant gas temperature conditions. The heaters are required since the boiler economizer outlet temperature varies with boiler load and can range between 580 and 700°F, while the design temperature for the SCR unit is a constant 700°F (although other temperature values will be tested).

Figure 2-5 shows a simplified sketch of the proposed large SCR reactor. For both the large and small reactors, the transition piece from the main supply duct must be designed to reduce the gas flow from 60 feet per second (fps) down to 14.6 fps and assure that the velocity components of flow are uniformly distributed across the reactor cross-section.

As the gas exits the large reactors, it will pass through a transition piece at the SCR reactor outlet and directly into the pilot air preheaters. Two pilot air preheaters will simulate full-scale utility rotary air heaters of slightly different design. The third air heater will be a heat pipe design.

As the flue gas exits each air heater, it will pass through a cyclone for particulate removal (to protect the ID fans), pass through a louvered damper (used to modulate flow based on venturi flow signals) and through an ID fan. The ID fan will have the capacity to operate between 3000 and 6000 scfm (with a design, continuous operating capacity of 5000 scfm).

2.1.2.3 Project Source Terms

Project source terms are resource requirements of the project as well as environmental residuals generated by the project; both of these components define the impacts of the project. Project source terms include, but are not limited to: land, labor, and fuel requirements, solid waste production, air emissions, and effluent discharges. When project source terms are

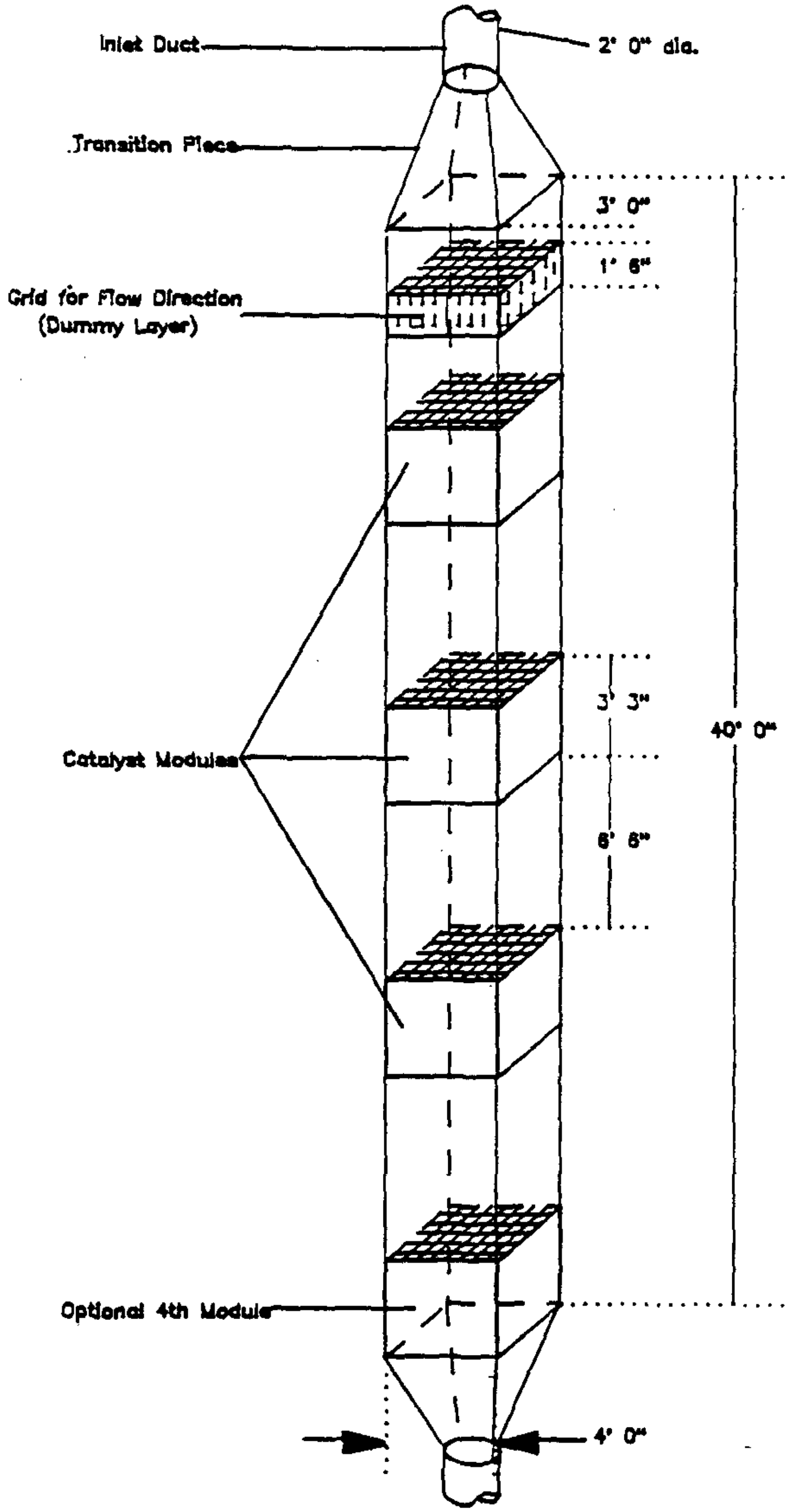

Figure 2-5. Sketch of Large SCR Reactor

applied to the existing environment (characterized in Section 3), the environmental impacts of the project can be identified and quantified (Section 4).

Resource Requirements

Since the proposed SCR project consists of modifications (with installation of relatively minor equipment) to a unit at an existing power plant, project resource requirements are very small. Table 2-2 compares the resource needs of the SCR project with those of the entire plant.

Estimated coal requirements are about 810,000 tons per year for both units involved in the demonstration. However, the SCR project will not require an increase in the amount of coal that Units 5 and 6 would otherwise use. Thus, no increased coal requirements are projected as a result of the project. Similarly, no additional water will be required except for quarterly washdowns of the air preheaters. This water (21,600 gallons per washdown) is less than one-tenth of one percent of daily water use at Plant Crist.

With respect to labor needs, the operation, site management, environmental, and regulatory compliance work will be accomplished by 8 existing Gulf Power Company employees, 2 new SCS employees, and 5 contract workers for a total operating staff of 15. Approximately 70 construction workers will be needed during the peak construction period.

The demonstration reactors will be located on an approximately 500 square foot plot adjacent to Units 5 and 6 (as shown in Figure 2-3). Other than this minimal requirement, there are no land needs associated with the project.

Additional power requirements will total approximately 1,900 kW at peak capacity. Annual consumption of electricity is estimated to be 5.7 million kWh. Electricity for the SCR project will be supplied by Gulf Power as if the project were any other large industrial customer. The SCR facility will be equipped with its own electrical distribution and metering equipment.

TABLE 2-2. SCR PROJECT RESOURCE REQUIREMENTS

Resource	Annual Plant Requirements w/o Project	Additional Annual SCR Project Requirements
Coal	2 million tons	None
Water	90,000 MMG	.0864 million gals
Operating Personnel	240	7 persons (70 in construction)
Ammonia	0	100,000 lbs (12,000 gallons)
Electricity	Not quantified, but typically 3% of plant capacity	5.7 million kWh
Land	680 acres	<0.1 acre (within the 680-acre site)

The power supplied to the project will not count as internal use but will be considered part of Gulf Power's "sales" to be purchased by Gulf Power and other members of the Southern electric system companies. This power requirement is well within the existing generating capacity of the system to service.

Ammonia consumption will be approximately 100,000 pounds per year. The ammonia, as well as the 2000-gallon ammonia storage tank, will be supplied by a contractor.

There will be no new off-site facilities (roads, rail, docks, pipelines, waste disposal facilities, or water intakes/discharges) as a result of implementation of the SCR project.

Environmental Residuals

The primary environmental effect of the project will be a slight reduction of NO_x emissions and a slight increase in emissions of ammonia (NH_3), sulfur trioxide (SO_3), and ammonium bisulfate (NH_4HSO_4). A literature review revealed concerns about the potential for the production of trace quantities of nitrosamine precursors and hydrogen cyanide in catalytic reactions, such as SCR. However, an analysis conducted for this report indicates that for SCR applications on coal-fired power plants the potential for generating measurable quantities of these substances is extremely remote. The likelihood of these occurrences is discussed in Section 4.1.

With the exception of quarterly preheater washdowns, no new wastewater streams will be generated. The preheater washwater will be managed in the existing plant wastewater system. The volume and characteristics of current effluents will not be significantly affected. Approximately 20 pounds per day of NH_4HSO_4 will be created as a solid waste, compared to the 800,000 pounds of fly ash generated per day. Based upon calculations which reasonably predict that the NH_4HSO_4 will be distributed in the fly ash, the NH_4HSO_4 concentration in the fly ash should be about 27 ppm. This concentration will not have a measurable impact on the properties of plant wastes.

2.1.2.4 Potential Environmental, Health, Safety, and Socioeconomic (EHSS) Receptors

Environmental, health, safety, and socioeconomic (EHSS) receptors are people, places, and environmental media that could be adversely or positively affected by the project. Examples of potential EHSS receptors for any type of project include: plant and project workers (i.e., occupational safety and health issues); nearby residents (adverse health effects, nuisance factors); area population (jobs, economic stimuli, increased demand for services); distant populations (downwind effect of emission changes); local ecology (statutorily protected or unprotected plants and animals); agricultural plants and animals; public recreational areas or scenic values (accessibility and enjoyment); and health effects and nuisance factors affecting adjacent commercial or institutional areas (such as campuses, shopping centers).

Based upon an evaluation of the possible range of potential EHSS receptors and the identification of project source terms (Section 2.1.2.3), the issues associated with potential EHSS receptors for this project are:

- Possible trace amounts of hydrogen cyanide (HCN) and precursors of nitrosamines in the air emissions which result from SCR treatment of flue gas from Units 5 and 6;

- Emissions of unreacted NH_3 from SCR operations;

- Economic stimulus to the local economy from project construction and operation;

- Employee safety and health concerns with respect to the storage and handling of pressurized ammonia and handling of catalyst elements; and

- Accidental release of ammonia from uncontrolled ammonia injections. However, the process control systems will be designed to feature multiple control interlocks which will result in automatic ammonia shutoff if certain operating parameters are exceeded.

These issues are addressed in detail in Section 4 (Consequences of the Project) of this Environmental Information Volume.

2.2 Alternatives

2.2.1 No Action Alternative

One primary goal of the DOE Innovative Clean Coal Technology program is to demonstrate the benefits of NO_x emission reduction through the use of innovative retrofit technologies on a variety of coal-fired boilers. The "no action" alternative, not demonstrating SCR, would significantly limit the available options for U.S. utilities for demonstrating NO_x reductions through the use of innovative retrofit technologies.

2.2.2 Alternative Sites

SCS evaluated 29 existing operating company fossil-fuel generating stations in Alabama, Georgia, Mississippi, and Florida. Criteria for selection included use of similar coals in two different types of collocated boiler configurations. The Crist plant was selected as the site for the SCR demonstration project because:

- Units 5 and 6 simultaneously burn a typical medium- to high-sulfur Illinois coal from the same mine;

- Unit 5 is a 75 MW tangential-fired boiler, while Unit 6 is a 320 MW wall-fired boiler--consequently, the flue gas NO_x concentrations from the two units differ substantially (estimated to be 400 and 900 ppm for Units 5 and 6, respectively);

- Unit 5 is equipped with a hot ESP; consequently, hot flue gas can be evaluated with both high and low ash loadings;

- Units 5 and 6 are collocated;

- The demonstration project will have minor EHSS impacts at the Crist plant due to the large size of the plant in relation to the project size (less than 1% of the flue gas treated); and

- No other plant site in the Southern Company electric system could meet all of the criteria mentioned above.

Locating the SCR demonstration project at the Crist plant will minimize any potential negative EHSS impacts of demonstrating this technology. Being able to use one SCR demonstration unit to test two different boiler firing types (one lower NO_x emissions than the other) minimizes EHSS impacts that would occur if two sites were evaluated. Additionally, because the Crist plant is large and meets all environmental regulations, the potential for noticeable environmental impacts from emissions of NH_3, SO_3, and NH_4HSO_4 due to the SCR demonstration project is minimal.

3.0 EXISTING ENVIRONMENT

Relevant environmental, socioeconomic, and cultural features of the existing plant site and surrounding area are described in this section.

3.1 Atmospheric Resources

3.1.1 Local Climate

The climate of northwest Florida is humid, and semi-tropical. Records for the 84-year period, 1879-1963, show an average temperature for the summer months (June, July, and August) of 80.7°F, with an average daily range of 12.5°F. The average winter temperature for the months of December, January, and February is 54.3°F, with an average daily range of 15.7°F. Historically, the temperature drops to freezing or below only nine days a year. Annual precipitation is about 60 inches. Rainfall is usually well distributed throughout the year with average measurable amounts 112 days a year. The greatest amount of rainfall normally occurs in July and August; the least in October. Temperature and precipitation data for Pensacola are summarized in Table 3-1. Winds are southerly, off the Gulf of Mexico, for most of the spring, summer, and early fall. The predominant wind direction in winter is northerly. Figure 3-1, the wind rose for Pensacola, indicates wind speeds between 4 and 16 mph may come from any direction, but that north and south winds generally have higher velocities. Periods of calm winds and temperature inversions are rare (Ref. 4).

3.1.2 Air Quality

The U.S. EPA and the State of Florida have established ambient air quality standards for each of six criteria pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter. The State of Florida's standards are identical to U.S. EPA's except for particulates and sulfur dioxide, where the state's standards are more stringent (Ref. 5). There are 260 monitors in Florida, several in Escambia and Santa Rosa counties

TABLE 3-1. PENSACOLA AREA TEMPERATURE AND PRECIPITATION DATA (1951 THROUGH 1980)

Month	Temperature Average Daily F° Maximum	Temperature Average Daily F° Minimum	Precipitation Average Monthly Total (inches)	Precipitation Average Monthly Snowfall (inches)	Precipitation Average No. of Days with ±1.0 inches
January	60.8	37.7	4.8	0.1	2
February	63.5	39.5	5.1	0.1	2
March	69.6	46.1	5.1	0.1	2
April	77.3	53.7	4.4	0.0	1
May	84.3	61.2	4.0	0.0	1
June	89.5	67.6	5.8	0.0	2
July	90.8	70.7	8.0	0.0	2
August	90.7	70.3	7.1	0.0	2
September	87.7	66.7	7.1	0.0	2
October	80.2	54.1	3.8	0.0	1
November	70.6	44.7	3.6	0.0	1
December	63.8	39.1	4.8	0.0	1
Year	77.4	54.3	5.3	0.03	1.5

Source: Climates of the States. Gale Research Company, Book Tower, Detroit, Michigan, 1985, p. 209.

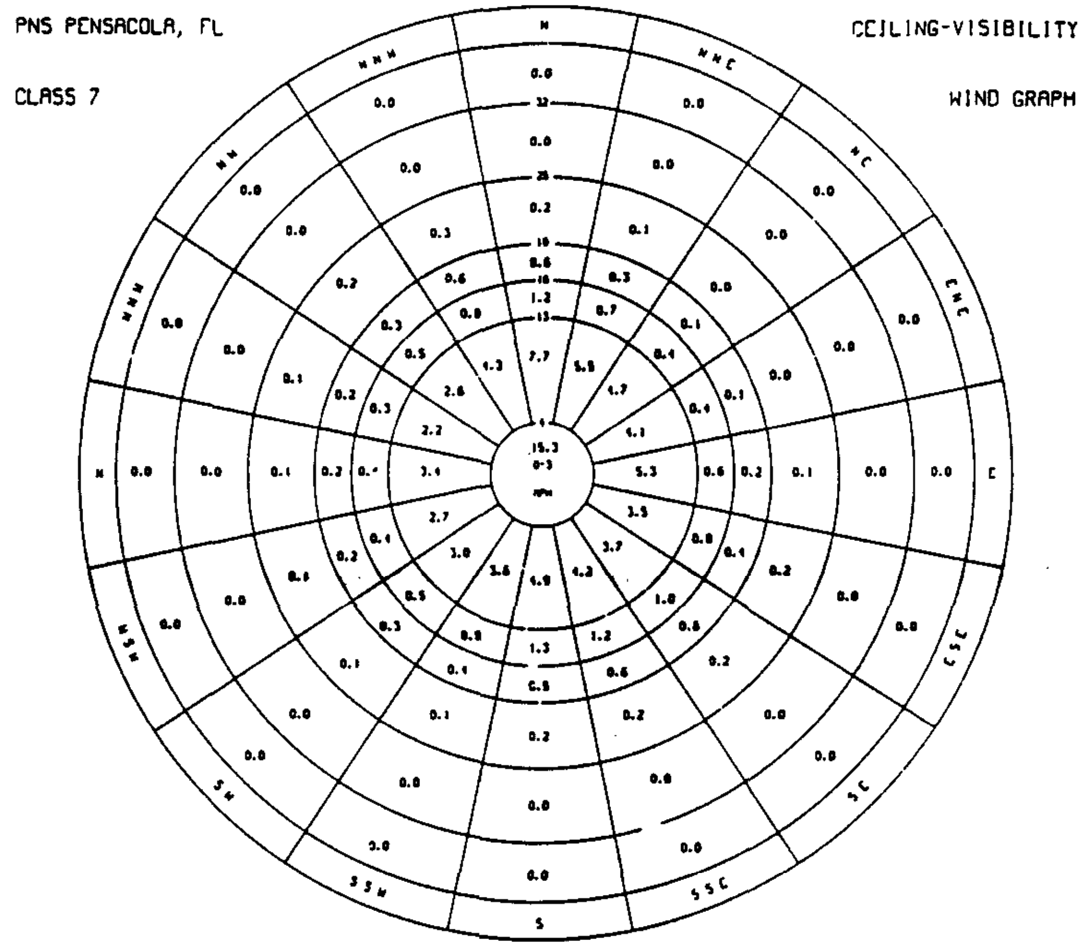

FIGURE 3-1. Composite Wind Rose for the National Weather Service Station at Hagla Field, Pensacola, Florida for the Periods of Record 1949–1954, 1965–1968, and 1970–1978

SOURCE: NOAA 1986.

U.S. GULF STRATEGIC HOMEPORTING
ENVIRONMENTAL IMPACT STATEMENT
DEPARTMENT OF THE NAVY SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

in close proximity to Plant Crist. Table 3-2 shows the two sets of standards for each criteria pollutant and the highest measured value for the years 1985 and 1986 for Escambia and Santa Rosa counties. These data show that the two-county area surrounding Plant Crist attains both federal and state ambient standards. The ozone exceedance was marginal and is allowable (i.e., ozone nonattainment occurs when there is an average of more than one exceedance over a three-year period) (Ref. 5). The plant is within the Mobile (Alabama) Air Quality Control Region (005).

Air quality at Plant Crist is monitored by Gulf Power using seven remote monitoring stations. All of the remote monitoring stations are equipped with SO_2 and particulate matter monitors (the state has not yet begun to measure PM-10 and therefore the only particulate matter data available is TSP). Two of the stations monitor NO_x. The most critical station, in terms of monitoring Plant Crist emissions is near Ellyson Field. The monitor is 3.7 miles southeast of Plant Crist. No violations of ambient air standards have been measured by the system monitors.

3.2 Land Resources

3.2.1 Topography

Plant Crist is located in the Coastal Plain Province. This area of the Coastal Plain is characterized topographically by Pleistocene marine terraces preserved as upland plateaus, flat-topped hills, low coastal plains, and benches along rivers and bays. At the plant site, topographic relief varies by more than 100 feet from sea level to 110 feet above sea level on the southwest part of the plant property (Ref. 6).

Current drainage systems at Plant Crist are designed to control flooding, soil erosion, and surface runoff. A comprehensive drainage plan for the area has been designed and is in place at the plant site.

TABLE 3-2. FEDERAL AND FLORIDA AMBIENT AIR QUALITY STANDARDS AND LOCAL MONITORING RESULTS

Pollutant	Averaging Times	Standard Federal	Standard Florida		Highest Values for Escambia/ Santa Rosa Counties (1985-1986)
Sulfur Dioxide	3 hour	--	1,300 $\mu g/m^3$	(0.5 ppm)	770 $\mu g/m^3$
	24 hour	365 $\mu g/m^3$	260 $\mu g/m^3$	(0.1 ppm)	155 $\mu g/m^3$
	Annual	80 $\mu g/m^3$	60 $\mu g/m^3$	(0.02 ppm)	30 $\mu g/m^3$
	3 hour[a]	1,300 $\mu g/m^3$			
Nitrogen Oxide	Annual	100 $\mu g/m^3$	100 $\mu g/m^3$	(0.05 ppm)	16 $\mu g/m^3$
Ozone	1 hour	235 $\mu g/m^3$	235 $\mu g/m^3$	(0.12 ppm)	0.13 ppm
Carbon Monoxide	1 hour	40,000 $\mu g/m^3$	40,000 $\mu g/m^3$	(35 ppm)	22 ppm
	8 hour	10,000 $\mu g/m^3$	10,000 $\mu g/m^3$	(9 ppm)	9 ppm
Total Suspended Particulates[b]	24 hour	260 $\mu g/m^3$	150 $\mu g/m^3$		146 $\mu g/m^3$
	Annual	50 $\mu g/m^3$	60 $\mu g/m^3$		47 $\mu g/m^3$
	24 hour[a]	150 $\mu g/m^3$			
Lead	Monthly	1.5 $\mu g/m^3$	1.5 μg/m3		N/A

[a]Secondary standard.

[b]Note: The federal standards for TSP have changed since the issuance of the report cited above. On July 1, 1987 EPA replaced the TSP standard listed above with a standard for particulate matter with aerodynamic diameters of 10 micrometers or less (PM-10). The 24-hour average limit under the PM-10 standard is 150 $\mu g/m^3$; the annual average is 50 $\mu g/m^3$.

Source: Ambient Air Quality in Florida 1986, Bureau of Air Quality Management, Florida Department of Environmental Regulation.

3.2.2 Soils and Geology

The soil profile at Plant Crist was formed on a wide variety of sediments of recent age or on Pleistocene terrace deposits. The soils therefore contain sand, silt, clay, gravel, and organic matter. Because the soils were formed on unconsolidated sediments, the soil/parent material contact is very gradational and the interface is difficult to determine. Plant Crist is underlain by a thick sequence (approximately 3,200 feet) of Tertiary-age sedimentary formations that dip southeastward at 30 to 40 feet per mile. These formations include shales, siltstones, limestones, clays, sands, and gradations of these lithologies.

Seismic occurrences do not pose a significant risk to Plant Crist. Although there are several faults in Escambia and Santa Rosa counties, the possibility of an earthquake is extremely unlikely (Ref. 7).

3.2.3 Land Use

An inventory of Escambia County land uses in 1977 (Ref. 7) indicates that 58 percent of the county is characterized as forested uplands, 5 percent are wetlands, 15 percent are in developed urban land uses, 17 percent are agricultural, and the remaining 5 percent are miscellaneous, including beaches, lakes, and mining areas. The Crist power plant boundaries include roughly equal areas of the forested uplands, marshy areas, ash disposal areas, and power plant structures.

Industrial, commercial, and residential development is very limited adjacent to the power plant. Although the plant is located in an unincorporated area, it does fall within the special zoning jurisdiction established to protect the University of West Florida. The area occupied by Plant Crist is zoned for heavy industrial uses. The areas north and east of the plant are unzoned, but they are wetlands. The area to the west of the plant is zoned for low-density residential uses. A sewage treatment plant is situated southwest of the plant in a light industrial-zoned tract. The campus of the University of West Florida borders the plant on the south.

3.3 Water Resources

3.3.1 Surface Water

The Escambia River basin is the single largest source of surface water in Escambia County and the fifth largest source in the state. The main channel starts near Union Springs, Alabama, at the Conecuh River, and flows southwestward to the Florida-Alabama line near Century, Florida. Near the state line, the name changes to Escambia River. The Escambia River flows southward and empties into the Escambia Bay north of Pensacola. The average flow from the Escambia River basin is estimated to be 7,000 cubic feet per second (cfs). The principal streams in the vicinity of Plant Crist are the Escambia River, Governors Bayou, Thompson's Bayou and Clear Creek.

The average yearly discharge data for the Escambia River in the vicinity of the Crist Electric Generating Plant is about 4,500 million gallons per day (Ref. 8). Plant Crist uses about 5 percent of this volume for once-through cooling.

The Escambia River is the receiving stream for all surface discharges associated with Plant Crist. The State of Florida has designated all of its rivers and streams according to one of four in-stream quality designations. According to the Water Quality Division of the Florida Department of Environmental Regulation (DER), the lower stretch of the Escambia River, which includes Plant Crist, is classified as Class III. Class III waters, which are a higher classification (i.e., more protected) than Class IV, are characterized recreational for "propagation and maintenance of a healthy, well-balanced population of fish and wildlife." Based upon in-stream monitoring, this section of the river attains the in-stream standards for Class III waters (Ref. 9).

3.3.2 Ground Water

Potable ground-water supplies come from the Floridian aquifer that underlies most of the state. At the site of Plant Crist, the aquifer lies approximately 1,000 feet below the surface. Water in this limestone aquifer is derived from rainfall in the outcrop areas in southern Alabama. None of the surface discharges and surface water near the plant affect the Floridian aquifer, which is separated from the surface by an 800-foot aquiclude of Miocene clay. Between this layer of clay and the surface are discontinuous interbeds of sand, clay, and gravel that form what is known in the area as the sand and gravel aquifer. This aquifer, or system of aquifers, is charged by rain falling on the surface.

The sand and gravel aquifer is a secondary source of water. Generally, the quality of ground water in northwest Florida is very good. Area ground water is very low in mineral content, having a hardness of less than 25 ppm, chloride between 3 and 15 ppm, and dissolved solids of 20 to 80 ppm. The high quality of the ground water is attributed to the natural filtration accomplished by percolation of a large volume of rainfall through quartz sand and gravel substrates (Ref. 10).

3.4 Ecological Resources

The flora and fauna that typify the Escambia County area can be grouped into three categories. These are described below in terms of dominant trees and associated fauna (Ref. 11). Escambia County is inhabited by some animal and plant species that are recognized at the state and federal level as being endangered, threatened, or of special concern.

The longleaf flatwoods are open woodlands dominated by three species of trees. These are (a) longleaf pine (*Pinus palustris*), (b) slash pine (*P. elliottii*), and (c) pond pine (*P. serotina*). The pond pines are usually accompanied by cypress and blackgum. Dominant ground cover includes wiregrasses, saw palmetto, gallberry, runner oaks, ground huckleberry, and bracken fern.

There is an abundance of frogs, salamanders, lizards, and snakes in these areas. Mammalian insectivores include shrews and the mole; mammalian herbivores include cottontail and marsh rabbit, cotton rat, pine vole, and white-tailed deer. Carnivores include skunk, opossum, raccoon, bobcat, and gray fox. Avifauna include the great horned owl, red-tailed hawk, chuck-will's-widow, Bachman's Sparrow, and the federally endangered red-cockaded woodpecker.

Pine flatwoods are frequently dotted with swampy depressions and minor drainageways that are occupied by small trees and shrub-bog species. These swamp systems, bay swamps, and titi swamps are usually fringed with evergreen shrub communities that include species such as the black titi (*Cliftonia monophylla*), swamp titi (*Cyrilla racemiflora*), and fetterbushes (*Lyonia lucida* and *Leucothoe racemosa*).

Many phases of swamps have been identified. Bay swamps may contain sweetbays (*M. virginiana*), swamp bay (*Persea borbonia*), blackgum (*Nyssa sylvatica*), cypress, red maple (*Acer robrum*), and Atlantic white cedar (*Chamaecyparis thyoides*). The understory of bay swamps include a mixture of switch cane (*Arundinaria gigantea*), wild azalea (*Rhododendron canescens*), muscadine (*Vitis rotundifolia*), and poison ivy (*Toxicodendron radicans*), to name a few.

Titi swamps are distinguished by their dense understory of shrubbery, dominated by black and swamp titi. Other common species include fetterbush, large gallberry (*Lex coriacea*), and switch cane. Ground cover is generally absent.

Two frogs are thought to be restricted almost exclusively to shrub bogs--the pine barrens tree frog (*Hyla andersonii*) and the bog frog (*Rana okaloosae*). Populations of the bronze frog, southern leopard frog, pine woods tree frog, and others occupy swamp when enough water is present for breeding.

Snakes, including the black racer (Coluber constrictor) and the endangered indigo snake (Drymarchon corais) forage in swamps for frogs.

Bottomland hardwood forests, which occupy the floodplains of Florida rivers such as the Escambia, contain cover that must be able to withstand saturated and inundated soils such as water tupelo (Nyssa aquatica), bald cypress (Fraxinus caroliniana), and sweetgum (Liquidamba styraciflua).

There is a wealth of consumer insects that feed on the many kinds of leaves. The avifauna that feed on the insects are dominated by wood warblers, such as the parula warbler (Parula americana), which breed only in the bottomland forests. The American beaver (Castor canadensis), once nearly extirpated from Florida, and the eastern wood rat (Meotoma floridana) are common herbivores (Ref. 11).

3.5 Socioeconomic Resources

The Pensacola urban area, comprised of Escambia and Santa Rosa counties, is one of the most rapidly growing areas along the Gulf Coast. The area's economy is influenced by the U.S. military, particularly the Navy. Compared to the state as a whole, the Pensacola area is younger, less affluent, and more mobile--all factors characteristic of an economy influenced by several military bases.

During the 1980s, the percentage growth in the two-county area outstripped that of Florida as a whole. (Florida is the fastest growing state in the U.S.) By 1990, Escambia and Santa Rosa counties are forecast to have a population of 380,900 and 68,800, respectively (Ref. 12).

Most of the growth in population is occurring in suburban and unincorporated portions of the two-county area. Only about one-fourth of the population resides in Pensacola, the only major urban center.

The military, and in particular the U.S. Navy, exerts a major influence on the region's economy. Of the approximately 130,000 persons employed in the two-county area in 1985, more than 13,000 were military personnel and another 11,000 were civilian employees and contractors to the military. Navy facilities in the region include the Pensacola Naval Air Station, Whiting Field, Sanfley Field, and an additional 13 training facilities (Ref. 7).

In 1980, the per capita income for Escambia and Santa Rosa counties was just over $6,100 compared to $7,270 for the state (Ref. 7).

The rate of unemployment for the two-county area was slightly higher than Florida's and similar to the national average. For 1986, Escambia and Santa Rosa counties averaged an unemployment rate of 6.3 and 7.7 percent respectively compared to Florida's rate of 5.7 percent and the U.S. rate of 7.0 percent.

The role of manufacturing in the economy of the area has declined over the past several decades. In the 1950s, manufacturing accounted for more than 25 percent of the nonfarm employment. It is now about 10 percent of nonfarm employment.

According to Pensacola Area Chamber of Commerce in 1986, Gulf Power Company (1,422 employees total) was the eighth largest employer in Escambia County and the 2nd largest industrial employer (Ref. 7). At the plant site itself, approximately 240 individuals are employed.

3.6 Aesthetic/Cultural Resources

Archaeological and historical surveys for Escambia County were researched through the Florida Department of State, Division of Historical Resources, to secure information regarding the possible presence of archaeological and historical sites in the immediate vicinity of Plant Crist.

3.6.1 Archaeological Resources

Research of the available archaeological surveys revealed a report that focused on three sectors of the City of Pensacola (Ref. 13). A number of sites were discovered that contained prehistoric and historic components. Archaeological deposits included: (a) those from Archaic sites that are 8,000-2,000 years old and are associated with freshwater features usually along tributaries or swamps; and (b) those from larger, later sites found along the shores of the bays and bayous, ranging in age from 2,000 to 300 years old. These more recent sites were occupied during the Woodland, Mississippian, and Historic stages.

No archaeological sites are known to exist within Plant Crist property boundaries.

3.6.2 Historical Resources

Beginning in 1977, the Historic Pensacola Preservation Board initiated a comprehensive study of the architectural and historical resources of Escambia County. However, efforts have been centered around Pensacola, the area that has dominated the attention of historical research in the county.

As of 1986, 27 Escambia County sites were listed in the National Register of Historical Places (Ref. 7). Examples of sites on the list include the Clara Barkley Dorr House and the Charles Williams Jones House, Forts George and Pickens, and other various buildings, such as a Sanger Theater and Pensacola Hospital. Since research efforts in the county have been focused on Pensacola, many of those listed historical sites are in that city. There is also a National Historic Landmark District at the Pensacola Naval Air Force Station, where numerous prehistoric shell middens are located around the fringes of the bay.

No historical sites are known to exist within the Plant Crist property boundaries.

3.6.3 Native American Resources

According to the National Bureau of Indian Affairs, there are two federally-recognized Indian tribes in Florida (Ref. 14). These are the Seminoles in Hollywood and the Miccosukees in Miami. These two locations are geographically distant from Plant Crist; therefore, there are no current tribal practices at or near the proposed project.

3.6.4 Scenic or Visual Resources

Plant Crist is not located near any federal or state protected scenic or recreational areas. The nearest federal area is the Gulf Islands National Seashore 29 miles to the south. The nearest state-owned preserve is the Blackwater State Forest located about 20 miles northeast of the plant. The nearest locally designated scenic areas or natural preserves are the Escambia Bay Bluffs 11 miles to the south, and the Yellow River Marsh Aquatic Preserve 12 miles east of the plant (Ref. 15). According to the State Department of Transportation, the State of Florida does not have a program by which scenic highways and vistas are designated and protected (Ref. 16).

3.7 Energy and Materials Resources

3.7.1 On-Site Resource Uses

3.7.1.1 Coal

Plant Crist consumes approximately 2 million tons per year of medium- to high-sulfur bituminous coal. The coal is barged down the Mississippi River and Intracoastal Canal from mines in West Virginia and southern Illinois. On an as-received basis, the typical range of proximate analyses of the Plant Crist coal are as follows (Ref. 2):

Percent Moisture:	7.5 to 9.9
Percent Ash:	9.0 to 10.0
Btu/lb:	12,000 to 12,200
Percent Sulfur:	2.6 to 3.0

This demonstration project will not require increased consumption of coal.

3.7.1.2 Water

Plant Crist consumes more than 200 million gallons of water per day--mostly for its once-through cooling processes. Other large uses include ash sluicing, boiler and air preheater wash water, and turbine and other equipment cooling. About 2 million gallons per day is withdrawn from ground-water sources for drinking water, condenser cooling, and other uses where higher quality water is required (Ref. 2). This demonstration project will require the equivalent of approximately 230 gallons per day of water (four air preheater washdowns per year of 21,000 gallons each) or about one-millionth of the current water withdrawals at Plant Crist.

3.7.1.3 Ammonia

Approximately 12,000 gallons per year of anhydrous ammonia will be used in the SCR demonstration project. This will require that the 2,000-gallon tank be filled once each six weeks over the course of the demonstration. Compared to the U.S. annual production of ammonia of about 20 million tons--primarily for use in agriculture as a fertilizer, this amount is insignificant (Ref. 17).

3.7.1.4 Electric Power

In order to power the fans and other equipment used in the SCR demonstration project, approximately 5.7 million kWh per year of electricity will be demanded. Compared to Gulf Power's capacity to provide for additional load requirements, the amount required for the SCR demonstration project is minor.

3.7.2 Potential Off-Site Competitors for the Resources

There are no known facilities, planned or existing, in the area that are competing for the small increase in water, the ammonia, or the electric power to be consumed by this project (Ref. 18).

4.0 CONSEQUENCES OF THE PROJECT

This section presents an analysis of anticipated environmental, health, safety, and socioeconomic impacts of the demonstration project.

4.1 Atmospheric Impacts

4.1.1 Conventional Pollutants

The proposed SCR demonstration project will result in a slight decrease in emissions of NO_x, a slight decrease in total emissions from the plant of SO_2, and a slight increase in emissions of ammonia (NH_3), sulfur trioxide (SO_3), and ammonium bisulfate (NH_4HSO_4). As shown in the table below, increases and decreases in air emissions are insignificant since the amount of flue gas being treated by the SCR demonstration unit is less than 1 percent of the flue gas generated by Plant Crist at full load.

The SCR demonstration project will reduce the treated flue gas NO_x emissions by approximately 70 to 90 percent. A small fraction (<2 percent) of the injected NH_3 will pass through the SCR reactor unreacted. A portion (80 to 90 percent) of this "slip" NH_3 will react with SO_3 to form NH_4HSO_4 (Ref. 19). A portion of the remainder will be adsorbed onto the fly ash (depending on the fly ash acidity). Equilibrium and kinetic data on NH_3-SO_3 reactions predict that between 10 and 20 percent of the slip NH_3 (i.e., <0.2 percent of the injected NH_3) will remain in the flue gas and be emitted from the power plant (Ref. 19). The following table summarizes the change in current air emissions from the Plant Crist due to the demonstration project:

Pollutant	Increase/Decrease During Demonstration	Pound Per Hour Change	Percent of Unit 5 and 6 Current Emissions
SO_2	Slight Decrease	0.016 - 0.08	0.00007-0.0003
SO_3	Slight Increase	0.02 - 0.10	0.0083-0.042
NO_x	Decrease	20 - 60	0.33-1.0
NH_3	Slight Increase	0.06 - 0.15	N/A

These changes in emissions are insignificant when compared to the current emissions of 24,000 lb/hr of SO_2, 240 lb/hr of SO_3, and 6,000 lb/hr of NO_x at full load on Units 5 and 6.

The air quality effects of the demonstration project were evaluated with conservative air quality screening models.

An air quality analysis of the annual average NO_x concentration associated with treatment of Unit 5 flue gas was undertaken using the U.S. EPA's Industrial Source Complex--Long-Term Model (ISCLT). The modeling results are presented in Appendix C. The parameters that were used are described in Table 4-1. The model results indicate that at every grid point modeled, there would be a slight decrease in NO_x concentrations. The change (decrease) in the maximum annual average ground-level concentration is estimated to be 0.017 micrograms cubic meter ($\mu g/m^3$). When this number is adjusted for the 1987 average capacity of 53 percent for Unit 5, the decrease is 0.009 $\mu g/m^3$.

An air quality analysis of the annual average NO_x concentration associated with treatment of Unit 6 flue gas was undertaken using the U.S. EPA's Industrial Source Complex--Long-Term Model (ISCLT). The parameters that were used are described in Table 4-2. The model results indicate that at every grid point modeled, there would be a slight decrease in NO_x concentrations. The change (decrease) in the maximum annual average ground-level concentration is estimated to be 0.019 $\mu g/m^3$. When this number is adjusted for the 1987 average capacity of 55 percent for Unit 6, the decrease is 0.01 $\mu g/m^3$.

In summary, the model results indicate that the worst-case annual average NO_x concentrations will decrease during operation of the demonstration project.

TABLE 4-1. AIR QUALITY MODELING ANALYSIS: NO_x ANNUAL AVERAGE -- UNIT 5

Plant:	CRIST - Case 1
Model Applied:	ISCLT
Pollutant Modeled:	NO_x: annual average
Modeling Scenario:	All gas to be treated is withdrawn from Unit 5 and returned to the Units 1-5 stack. Units 1-4 remain unchanged. The 100% NO_x emission rate for Unit 5 is reduced from 125 grams/second to 120 grams/second. The stack for Units 6 and 7 remains unchanged and is not modeled. In order to have the model estimate the change in air quality resulting from the decrease in emission rate, the stack for Units 1-5 is modeled with a negative emission rate of -5 grams/second. A 361-point 2km x 2km receptor grid was used.
Stack Parameters:	
X Coordinate (UTM)	478.60
Y Coordinate (UTM)	3381.30
Emission Height (meters)	130.50
Gas Exit Temperature ('K)	415.90
Gas Exit Velocity (meters/sec)	16.00
Stack Diameter (meters)	5.49
Change in Emission Rate (grams/sec)	-5.0
Meteorology:	
Ambient Air Temperature	293.37° Kelvin
Mixing Height Layer	1150 Meters
Wind Rose	Pensacola, FL / Forest Sherman NAS Station 03855 January 1967-December 1971
Modeling Results:	
Change in the Maximum Annual Average Ground-Level NO_x Concentration	0.017 micrograms/cubic meter decrease
Change in the Maximum Annual Average Ground-Level NO_x Concentration (adjusted for 1987 Unit 5 average capacity of 53%)	0.009 micrograms/cubic meter decrease

Source: Southern Company Services, Environmental Assessment Department, Research and Environmental Affairs.

TABLE 4-2. AIR QUALITY MODELING ANALYSIS: NO_x ANNUAL AVERAGE -- UNIT 6

Plant:	CRIST - Case 2
Model Applied:	ISCLT
Pollutant Modeled:	NO_x: annual average
Modeling Scenario:	All gas to be treated is withdrawn from Unit 6 and returned to the Units 6 and 7 stack. Units 1-5 remain unchanged. The 100% load NO_x emission rate for Unit 6 is reduced from 508 grams/second to 495.7 grams/second. The stack for Units 1-5 remains unchanged and is not modeled. In order to have the model estimate the change in air quality resulting from the decrease in emission rate, the stack for Units 6 and 7 is modeled with a negative emission rate of -12.3 grams/second. A 361-point 2km x 2km receptor grid was used.
Stack Parameters:	
X Coordinate (UTM)	478.50
Y Coordinate (UTM)	3381.30
Emission Height (meters)	137.16
Gas Exit Temperature (°K)	404.30
Gas Exit Velocity (meters/sec)	29.60
Stack Diameter (meters)	7.06
Change in Emission Rate (grams/sec)	-12.3
Meteorology:	
Ambient Air Temperature	293.37° Kelvin
Mixing Height Layer	1150 Meters
Wind Rose	Pensacola, FL / Forest Sherman NAS Station 03855 January 1967-December 1971
Modeling Results:	
Change in the Maximum Annual Average Ground-Level NO_x Concentration	0.019 micrograms/cubic meter decrease
Change in the Maximum Annual Average Ground-Level NO_x Concentration (adjusted for 1987 Unit 6 average capacity of 55%)	0.01 micrograms/cubic meter decrease

Source: Southern Company Services, Environmental Assessment Department, Research and Environmental Affairs.

There is likely to be a very slight increase in particulate levels from ammonium bisulfate emitted in a particulate form. The maximum daily rate of particulate loading from this reaction is estimated to be about one pound per day, assuming normal particulate capture levels, the maximum ammonium bisulfate formation, and near continuous operation of the SCR unit. This is 0.01 percent of the total particulate matter emitted by the plant, which averaged 7,671 pounds per day during the latest year for which emissions data are available (Ref. 31).

Although the data in Table 3-2 indicate that monitored levels of particulate matter are near the standard, the most recent particulate matter available from the State of Florida's high-volume particulate monitor at Ellyson Field (less than 3 miles southeast of Plant Crist) shows that the highest and second highest particulate matter levels were 112 $\mu g/m^3$ and 105 $\mu g/m^3$, respectively in 1987, and 86 $\mu g/m^3$ and 74 $\mu g/m^3$ in 1988. These were well below the high value recorded in 1985-1986 in Table 3-2 of 146 $\mu g/m^3$ and well below the TSP federal standard of 260 $\mu g/m^3$ and the state standard of 150 $\mu g/m^3$.

More to the point are the PM-10 measurements taken by Gulf Power. Data from Gulf Power's Brentwood ambient air monitoring station (7 miles SSW of Plant Crist) indicate that PM-10 levels are approximately one-half the NAAQS (26 $\mu g/m^3$ versus the 50 $\mu g/m^3$ set as the new NAAQS). The state has not yet begun to monitor for PM-10 and therefore these data are the best and most recent indicator of attainment (Ref. 33).

Therefore, although the increased particulate loading due to ammonium bisulfate have not been modeled, it is highly unlikely that there will be any adverse impacts given the recent low background concentrations monitored and the very small increase in ammonium bisulfate production anticipated.

4.1.2 Other Potential Emissions

Concentrations of NH_3 in the flue gas are not expected to exceed 5 ppm. Even if no dispersion were to occur between the stack and human receptors, this level is far below the 50 ppm permissible exposure level established by the U.S. Occupational Safety and Health Administration for workers exposed to NH_3.

Because SCR has not yet been demonstrated on eastern U.S. coals, there is some uncertainty regarding potential by-products from NH_3 (ammonia) reactions. A review of the domestic and foreign literature was conducted to investigate these issues. The concerns focus on the potential that NH_3 can react to produce cyanide compounds and nitrosamines.

Two sets of data from stack testing on SCR-equipped facilities demonstrate the potential for cyanide formation. In the first, a 1500 kw gas-fired generator with 1500 to 1800 ppm hydrocarbon (HC) levels going into the SCR unit resulted in the production of 1.3 ppm of hydrogen cyanide (HCN) (Ref. 20). In the second, tests on a coal-fired utility boiler with HC stack concentrations at or below 5 ppm showed that there were no increases in HCN across the SCR unit. However, when the flue gas was spiked with 560 ppm of HC, the HCN concentrations increased from 0.14 ppm upstream of the SCR to 0.43 ppm downstream (Ref. 21).

These data show that although HCN can be formed in SCR processes, it only occurs when HC levels are 10 to 100 times what is typical of a coal-fired utility boiler like those at Plant Crist. Although there are no HC stack data available for the Plant Crist units, levels of 5 ppm or higher would not be expected. Stack sampling conducted by Radian at another coal-fired plant in the Southern company electric system showed HC levels at less than 1 ppm (Ref. 22). In addition, these same tests showed that HCN concentrations up and downstream of a pilot SCR were less than 0.01 mg/dscm. Therefore, the formation of HCN by the proposed SCR project is extremely unlikely.

The other concern that has been expressed in the literature about SCR systems is the potential for the production of aliphatic amines, which, in the presence of NO_x and in the absence of sunlight, form nitrosamines (Ref. 23). Nitrosamines have been classified by the International Agency for Research on Cancer as a potential carcinogen in humans (Ref. 23). In the only reported study of potential cancer risks associated with SCR (a risk assessment by Alanova, Inc., of a proposed SCR-equipped gas-fired cogeneration plant), it was estimated that under a worst-case scenario the production of aliphatic amines (specifically dialkyl amine) could result in an increased cancer risk of 200 per one million persons (Ref. 23).

Although no measurements of aliphatic amines have been made on SCR systems, the Alanova study based its calculations on measurements of aliphatic amine formation from the exhausts of automotive catalysts. In this automotive catalyst study (Ref. 24), the levels of HC in the exhaust gases were at least 10 to 100 times higher than concentrations in the exhausts from coal-fired power plants equipped with SCR units. Ammonia concentrations in the automotive exhausts ranged up to 100 times the ammonia levels normally found in the stack gases of coal-fired power plants with SCR units.

To estimate the concentrations of dialkyl amine that could form from the exhausts of a coal fired SCR-equipped system, Radian performed an equilibrium analysis. The equilibrium calculations estimated the maximum rate at which diethylamine $(NH)_2(C_2H_5)$ that could be formed under SCR operating conditions. These calculations were performed using a computer program which determines chemical equilibrium using the technique of free energy minimization. The reaction which was evaluated using this equilibrium calculations was:

$$2\ C_2H_6 + NH_3 \rightarrow NH(C_2H_5)_2 + 2H_2$$

The calculations were based upon 350 °C, atmospheric pressure, 5 ppm NH_3 and 5 ppm C_2H_6. This calculation was made with diethylamine as the only possible reaction product. This, combined with the fact that it was an equilibrium calculation, makes this a worst-case scenario. Based on this calculation, Radian estimates that the maximum possible diethylamine concentration in the SCR reactor exit is 3.0×10^{-10} ppm. This result establishes that nitrosamine precursor formation should not present an environmental or health effect problem from use of the SCR demonstration process.

4.2 Land Impacts

This project will not require additional land acquisition, nor will there be any change in the current use of the land. Construction and operation will occur in the heart of the facility where the land is already used for road and paved access space. Construction activities will be confined to an area of less than an acre. The operation of the SCR project will occupy an area of approximately 500 square feet between Units 5 and 6. With minor exceptions, existing roads, parking areas, equipment laydown areas, and structures will be used. The only new structures include:

- A 2,000 gallon anhydrous ammonia tank will be located on grade level under the existing Unit 4 electrostatic precipitator (ESP);

- The three large reactor units (with air preheaters, fans, and auxiliary equipment) and the six small reactor units will be vertical structures that are above grade level and attached to the boiler superstructure; and

- Control room on top of pilot facility superstructure.

Current plans call for these structures to be dismantled at the end of the two-year operating period. Therefore, even the minimal land and space requirements should be considered temporary.

4.3 Water Quality Impacts

Selective catalytic reduction is a dry process in which gaseous NH_3 reacts with NO_x to produce N_2 and H_2O. Under projected worst-case conditions of a 5 ppm NH_3 slip through the SCR reactor, the catalytic reaction will still consume more than 98.4 percent of the injected NH_3. Some of the slip NH_3 will react with SO_3 to form and condense as solid NH_4HSO_4, ammonium bisulfate. The maximum amount of ammonium bisulfate estimated to be formed during the demonstration project is approximately 20 lb/day.

Assuming that ammonium bisulfate condenses as a sticky semi-solid, most of it will be collected in the electrostatic precipitator during the soot-blowing of the small-scale air preheaters. This material will be distributed in the ash pond and fly ash disposal landfill. Because ammonium bisulfate is soluble in water, some of it may be dissolved in the ash pond discharge water and landfill leachate. However, the amount of ammonium bisulfate formation (about 1 lb/hr) is very small compared to the total volume of ash pond water discharge of 7.8 million lbs/hr. If all the ammonium bisulfate was distributed in Plant Crist's total fly ash volume, the concentration would only be about 27 ppm. Consequently, the concentrations of ammonium bisulfate that could possibly be present in the leachate and discharged to the surface water will be insignificant.

4.4 Solid Wastes

The only solid waste potentially associated with SCR application is spent SCR catalyst material. Each large reactor will utilize approximately 4,600 pounds of catalyst. It is not clear whether, in fact, catalyst will have to be removed over the life of the project; the continued effectiveness of the catalyst is a parameter to be monitored during the project. The spent SCR catalyst, if generated, will be predominantly titanium dioxide (TiO_2) with small amounts of vanadium pentoxide and tungsten and molybdenum trioxide. Commercial practice in Japan is for all spent catalyst to be returned to the manufacturer in order to protect the proprietary composition of the catalyst.

Japanese manufacturers typically grind the catalyst and dispose of it in cement. In West Germany, catalyst is also shipped back to the manufacturer. However, some catalyst manufacturers are exploring ways to recycle and reclaim the catalyst.

Spent SCR catalyst is not listed as a hazardous waste under the Resource Conservation and Recovery Act or implementing state programs. Testing of spent catalyst by the Electric Power Research Institute revealed that the spent catalyst that was tested was not characteristically hazardous under the Extraction Procedure toxicity test or the proposed Organic Toxicity Characteristic (Ref. 25). Specific testing will be conducted on the demonstration project's spent catalyst. Regardless of the results, catalyst manufacturers and SCS have agreed that SCS will immediately return all spent SCR catalytic material in order to protect the proprietary nature of the catalyst and disposal composition (Ref. 26). This procedure will ensure that long-term storage of the material, with potential human exposure concerns, will not occur at the site.

4.5 Ecological Impacts

Because of the small volume of flue gas to be treated (less than 1 percent of total flue gas) and the insignificant increases and decreases in emissions, the proposed project is expected to have no effect on the surrounding flora and fauna. Construction and operational activities will occur within developed portions of the plant and, therefore, no habitat destruction will occur. For these reasons, specific contacts with the federal and state fish and wildlife agencies were not initiated.

4.6 Socioeconomic Impacts

An average of 30 to 35 construction personnel will be required during the 12-month construction period. The peak work force will be about 70 persons. It is anticipated that most of the contract personnel will come from local construction firms. In addition to the construction work force, there will be professionals familiar with the SCR technology at the plant site for short periods of time.

Operation of the SCR demonstration unit will require participation of at least 15 individuals. Eight Plant Crist personnel will be reassigned to the project. The net increase in contract employment (during the operational stage) as a result of this project will be five (3 maintenance workers, 2 analytical chemists). This number represents approximately a 2 percent increase in current contract and permanent employment level of 240 persons at Plant Crist (Ref. 2). Two new SCS engineers will be hired to work on-site during the project.

Socioeconomic impacts from energy production projects result from an influx of construction workers (and to a lesser extent, operational employees) and their families, which, in turn, create demands on the community's infrastructure (utilities, roads, housing) and services (education, police, etc.). Given the magnitude of surrounding population and the relatively small number of construction workers and operating staff, these impacts will be minimal and positive (i.e., slightly increased payrolls) over the three-year period.

4.7 Aesthetic/Cultural Resources Impacts

As noted above, the proposed SCR demonstration project will not result in the disturbance of any undeveloped land. Therefore, there is no potential for destruction of archaeological artifacts or historical structures. For this reason, no site-specific contacts with the Florida State Historic Preservation Office were initiated.

Also, the proposed project is anticipated to have no adverse visual impact. No smoke plumes or other highly visual characteristics will be associated with the project. The additional hardware and structures will not be readily apparent to casual visitors and, in any event, would not be considered out of character with a power plant. Plant Crist is in a relatively remote location and is not readily accessible by the general public.

4.8 Employee Safety and Health Impacts

Plant Crist has an outstanding safety record. During the past ten years there have been two periods in which the plant recorded one million consecutive man-hours of no lost time due to accidents (Ref. 27). New employees are given safety training as part of the specific training associated with their assignments. Gulf Power's safety procedures are documented in its Safe Work Practices provided to all employees.

Plant Crist has a routine safety program administered by its Safety and Training Supervisor. Safety is specifically addressed in monthly shift meetings and more intensively each quarter in large group settings. For those employees who will be reassigned to, or otherwise involved in, the proposed SCR project, there will be specific training related to those aspects of the project that are new to the plant (Ref. 27).

The only significant employee safety and health issue posed by the proposed SCR project is the handling, storage, and use of the ammonia to be injected in the reactors. Ammonia is highly toxic to humans. Concentrations above 5,000 ppm can cause blindness, lung damage, or death. It is not a known carcinogen and at low concentrations (1 ppm or less) has no adverse effects (Ref. 28). The permissible exposure limit (PEL) for workers over a 40 hour period is 50 ppm. It is readily detectable by smell at 5 ppm or about one-tenth of the PEL. Typically, detection devices are not necessary. The greatest potential threat to employees is from tank ruptures or large leaks (Ref. 29).

There are two aspects to this issue:

- The potential for an ammonia release from the 2000-gallon storage tank, or the potential for a release during routine handling (loading and storage); and

- The possibility of a failure in the SCR system in which ammonia continues to be injected when the reaction is not taking place thereby resulting in unreacted ammonia being emitted.

Plant Crist will reduce the potential for an accidental ammonia release from the 2000-gallon storage tank by employing design, construction and operation practices that meet or exceed industry standards. The procurement, installation, loading and unloading of the storage tank will be handled by an experienced licensed contractor (Ref. 27). The 2000-gallon storage tank will be constructed in accordance with local and national codes (ASME-ANSI K-61 Tank Code). The tank will be located at ground level and in a location where it will not be subject to rupture by heavy equipment. Also the control room for the SCR project will be located 400 to 500 feet away from the tank which would mitigate the impact of any catastrophic ammonia leak (Ref. 27).

According to a spokesman for one of the contractors being considered by SCS and Plant Crist, the truck driver who will make the deliveries of ammonia will be trained and properly equipped to safely perform the delivery. Normal precautions include the wearing of rubber gloves and goggles to protect against the caustic burns and the formation of ammonium hydroxide on mucous membranes. Drivers also carry NIOSH-approved respirators in case there is a major ammonia leak (Ref. 29). Plant Crist currently stores and uses and has instituted safety measures for pressurized liquid chlorine; similar procedures for addressing ammonia will be developed.

An accidental release of ammonia could potentially occur if uncontrolled ammonia injection to the SCR developed. Although the final design of the process control system has not been completed, control interlocks will be incorporated to prevent an ammonia release. This system will include, for example, ammonia shutoff if the temperature in the SCR declines significantly. If the reduction reaction declines, unreacted ammonia could pass through the SCR unit and be emitted to the atmosphere. Thus, an ammonia shutoff mechanism will prevent such an accidental release. Similarly, the flow rate of the injected ammonia will be monitored, and an excessively high rate will trigger an ammonia cutoff.

One other potential employee safety and health issue is associated with handling of the catalyst material. However, the avenues for exposure should be minimal, and may only occur during initial placement and ultimate removal of the material. At these times, employers will take proper safeguards to protect from dermal contact and inhalation. If spent catalyst is required to be removed during the operations phase of the project, the material will be protectively encased for shipping and then temporarily stored on site (few days) prior to off-site transport.

4.9 Impact Summary

In summary, the proposed SCR project will have no significant impacts on the existing environment.

SCR is essentially a dry process, but will result in an inconsequential increase in the volume of wastewaters generated at the plant as a result of preheater washings. Ammonium bisulfate may be formed and then distributed in the fly ash. However, the estimated rate of formation is so low, that wastewater characteristics and water quality are not expected to be impacted. Because less than 1 percent of the plant's total flue gas volume will be routed through the catalyst units, there will be limited potential to affect, either positively or negatively, the character of the emissions. An insignificant reduction in total plant NO_x emissions is anticipated.

Because no additional land will be disturbed by the project, there should be no ecological (e.g., habitat destruction), land use, or archaeological impacts from this project. The minor construction and operating personnel requirements will result in a slight positive economic impact to the community with no countervailing socioeconomic impacts.

Three potential issues associated with the SCR process were examined to determine whether they would pose a significant risk to human health. The first relates to the potential creation of airborne carcinogenic precursors, a possible unintended by-product of SCR. The other two issues were the risk to safety and health of employees from (a) ammonia use and storage and (b) handling of catalytic materials which contain metals. As described in Section 4.8, appropriate safeguards will be built into the system and employee training provided to minimize these risks.

4.9.1 Mitigation Measures

As discussed in the preceding section, the impacts anticipated as a result of this project are insignificant. Therefore, no emission or wastewater impact mitigation strategy and plan needs to be developed. With respect to employee safety and health concerns associated with ammonia use and storage, design features will be incorporated into the process control equipment and the storage tank to significantly minimize the potential for an ammonia release. Persons assigned to the project will be trained in the potential hazards of ammonia handling. With respect to catalyst handling, there should be minimal chances for employee exposure. During placement and removal activities, appropriate protective equipment will be used.

4.9.2 Monitoring

The test phase of the demonstration project includes a number of monitoring activities that are designed to evaluate process efficiency and environmental parameters of the project. These activities are NEPA-independent; i.e., they are driven by the requirements of the ICCT program itself, as well as conventional regulatory compliance requirements. However, the activities will yield data relating to potential impact-forcing source terms of the project. Following is an overview of the monitoring that is anticipated for the test phases of the program that is relevant to environmental effects.

The SCR project will gather baseline particulate data to verify that the SCR flue gas extraction and delivery system is providing the SCR reactors with representative gas samples. In addition to these particulate measurements, a number of flue gas pollutants will be measured, including:

- Baseline measurements of HCl, NH_3, SO_3, and NO_2 in the flue gas;

- Initial calibration of all extractive gas sampling system monitors (using certified span gases); and

- Baseline flue gas composition via extractive sampling system (to include O_2, CO_2, CO, NO_x, SO_2).

The measurement of conventional flue gas species (i.e., O_2, CO, CO_2, NO_x, and SO_2) will be accomplished throughout this program by use of an extractive gas sampling system and continuous gas analyzers.

Once these data have been collected, the large SCR reactor air preheater trains will be sequentially evaluated in a series of parametric tests in order to evaluate the assumptions used to design the system for operation on medium- to high-sulfur coal.

Once parametric testing is completed, the reactor will be returned to either the original design operating conditions or operating conditions defined as optimal during the parametric testing. The reactor will operate in this condition for the duration of the project while deNO_x efficiency, slip NH_3, NH_4HSO_4 formation, and air preheater performance are monitored. During long-term SCR catalyst durability testing, the air preheater's performance will also be evaluated.

5.0 REGULATORY COMPLIANCE

This section describes the regulatory programs currently applicable to the plant and how these programs will or will not be affected by the project.

5.1 Air Quality

Plant Crist has been issued seven operating permits by the Florida Department of Environmental Regulation (DER), for the seven units at the plant (Ref. 3). In addition, an air quality permit has been issued for the operation of two fly ash storage silos. The generating unit permits impose a particulate matter emission limit of 0.10 lbs/MMBtu for all units and an SO_2 limit of 1.88 lbs/MMBtu for Units 1 through 3 and 5.9 lbs/MMBtu for Units 4 through 7. In addition to the regulatory requirements, an ambient air monitoring network, consisting of seven remote stations, a meteorological tower, and a data acquisition system has been established at Plant Crist. This system, which was established after consultation by and concurrence with the Florida DER and U.S. Environmental Protection Agency (U.S. EPA), monitors ambient SO_2, NO_x, and particulate matter concentrations. Results are reported quarterly to the regulatory agencies.

The SCR demonstration project is a slipstream facility that will consist of three 2.5 MW pilot reactors and six 0.05 MW pilot reactors. These reactors will draw flue gas from Units 5 and 6, as discussed previously. Although the prototype plant should achieve approximately 80 to 90 percent reduction in NO_x emissions from the flue gas that is treated, this gas volume is less than 1 percent of the plant's total gas volume; little overall effect on the plant's NO_x emissions is expected. SO_2 emissions are expected to slightly decrease.

According to the Florida DER (Bureau of Air Quality Control), a modification of operating conditions, even if temporary and resulting in no net increase in emissions, would likely require a permit (Ref. 30). However, the SCR project meets an exemption provided for in Florida's air quality rules; Sec. 17-103.120, that allows the department to grant a temporary exemption to permitted sources for purposes of "testing and research." This exemption is not extensively utilized, in part because the granting of such exemptions require U.S. EPA approval of Florida's State Implementation Plan (SIP). However, in this instance, where there will not be a net increase in emissions, a SIP change would not be required. Thus, the testing and research exemption rule appears to be the least burdensome means of compliance.

The demonstration project will not trigger new source review. Therefore, it is not affected by Prevention of Significant Deterioration (PSD) regulation. Also, the proposed temporary modification is not affected by a New Source Performance Standard (NSPS) or a National Emission Standard for Hazardous Air Pollutants.

5.2 Wastewater

Plant Crist has been issued a National Pollutant Discharge Elimination System (NPDES) permit from the U.S. EPA. Since the State of Florida has not been delegated primacy for the NPDES program, a separate wastewater discharge permit from the Florida DER has also been issued. These permits authorize the discharge of plant water from the following outfalls: ash pond overflow, metal cleaning wastes discharge, cooling tower blowdown, coal pile runoff, and main plant discharge. In addition, the state permit incorporates a ground-water monitoring program requirement. This program, imposed pursuant to the Florida water quality standards and water quality permitting rules, assesses the impact of operation of the power plant on ground-water quality. Operation of the SCR demonstration project will not significantly affect the volume or characteristics of the existing plant wastewater. Therefore, no amendments to Plant Crist's federal and state permits should be required.

5.3 Solid Waste

Bottom and fly ash are currently collected separately, and then conveyed to an on-site landfill permitted by the Florida DER. Bottom ash sluice water is conveyed to an ash pond; the intermittent discharge from the pond is regulated under federal and state wastewater discharge permits. Operation of the SCR demonstration unit should not result in a significant change in the volume or characteristics of ash generated, and permit amendments should not be required. A small quantity of NH_4HSO_4 will be captured in the electrostatic precipitator (i.e., 19.4 lbs NH_4HSO_4 daily average values versus an average daily value of 571.4 tons of fly ash for the entire plant). This amount is so small that it is not anticipated to require any special regulatory consideration.

It is not anticipated that the SCR demonstration project will result in the generation of hazardous waste as that term is defined under the federal Resource Conservation and Recovery Act (RCRA) and the Florida Resource Recovery and Management Act. Spent catalyst is not a listed waste. Characteristic testing of spent catalyst by EPRI indicated that the material was not RCRA hazardous under the E.P. toxicity or proposed Organic Toxicity Characteristic.

The SCR process utilizes a catalyst that contains vanadium pentoxide, titanium dioxide, and possibly tungsten and molybdenum trioxide. In a commercial plant, it might be assumed that the catalyst would exhibit a replacement rate of 25 percent per year. For the Plant Crist demonstration project, any spent catalyst that is generated will be promptly transported back to the vendor at the conclusion of testing for proprietary reasons. No spent catalytic material will be disposed of on site. Therefore, no permitting will be required.

5.4 Water Supply

Surface water is readily available and is utilized to supply water requirements of Plant Crist. As described in Section 3.7.1.2, the SCR process will require only minimal additional water for preheater cleaning and will not necessitate an amendment to the plant's appropriation authorization.

5.5 Health and Safety Compliance

The health and safety requirements applicable to operation of the proposed SCR project include the "general industry" and "construction" standards of the federal Occupational Health and Safety Administration. These standards include requirements relating to walking or working surfaces, means of ingress and egress, operation of powered equipment, adequate ventilation, noise exposure controls, fire protection, and electrical equipment safeguards. In addition, OSHA standards at 29 CFR Section 1910.111, relating to the storage and handling of NH_3, will be observed. Plant employees are already instructed in worker protection and safety procedures in the existing plant operations manual (Ref. 27). It is anticipated that current procedures, with some updating, will adequately ensure that federal and state standards are met. During construction, the contractor will comply with site health and safety requirements.

It is likely that an emergency planning notice will be required under the federal Superfund Amendments and Reauthorization Act (SARA) Title III (Emergency Planning and Community Right-To-Know). It is planned that greater than 500 lbs of NH_3, designated as an extremely hazardous substance, under the SARA Title III rules, will be stored on site. The emergency planning notice will be provided to the following State of Florida and Escambia County emergency planning entities:

Florida Emergency Response Commission
2740 Centerview Drive
Tallahassee, Florida 32399
(904) 488-1472

West Florida Regional Planning Commission
3435 N. 12th Avenue
Pensacola, Florida 32503
(904) 444-8910

Escambia County Civil Defense
2920 North L Street
Pensacola, Florida 32501
(904) 436-9700

Since the SARA process is not a permitting process, there are no time delays associated with compliance with the notice requirement.

5.6 Floodplain/Wetlands

5.6.1 Floodplain

Appendix A to this document presents a floodplain map of Plant Crist. Although portions of the plant are located in floodplain areas, none of the demonstration equipment will be in the 50 to 100 year floodplain. Thus, there will be no impacts to floodplain values, and no state/local floodplain protection programs will be applicable to the demonstration project.

5.6.2 Wetlands

The primary regulatory significance of the presence of wetlands at a project relates to the dredge and fill permitting program of the U.S. Army Corps of Engineers (COE). The U.S. COE issues permits for, among other things, the discharge of dredged or fill material into wetlands that are adjacent to "waters of the U.S." None of the elements of the SCR process are expected to impact wetland areas.

5.7 State Environmental Impact Assessment Program

The Florida DER administers an environmental impact assessment program for electric power plants through implementation of the Florida Electrical Power Plant Siting Act (FEPPSA). The FEPPSA certification process is a "one-step" permitting program for the construction of new electric power plants or expansion in steam generating capacity of existing power plants.

Sociopolitical and biophysical impacts of the project must be identified and assessed in a NEPA-type process at the state level.

The provisions of FEPPSA will not apply to the selective catalytic reduction demonstration project at Plant Crist because the project will not result in an increase in steam generating capacity of the existing power plant. Therefore, there are no state environmental impact assessment procedures applicable to the demonstration program.

5.8 Coastal Zone Management

The Florida DER administers a coastal preservation program through the implementation of the Florida Beach and Shore Preservation Act. The intent of the program is to preserve and protect the state's beaches from imprudent construction that can (a) accelerate erosion, (b) endanger adjacent properties or upland structures, or (c) interfere with public access. On a county basis, coastal construction control lines were established along sand beaches that front on the Atlantic Ocean, Gulf of Mexico, and Straits of Florida.

The provisions of the Florida coastal preservation program will not apply to the Plant Crist SCR project because it will be performed on an existing structure that is not located in the county's coastal construction control zone. Therefore, there are no state coastal zone procedures applicable to the demonstration project.

6.0 LIST OF PREPARERS AND PROFESSIONAL QUALIFICATIONS

This Environmental Information Volume was prepared by Radian Corporation. The qualifications of the principal project members are summarized below. Appendix B consists of the resumes of these individuals.

The Project Director for preparation of this report is Dr. Robert G. Wetherold, a chemical engineer with 23 years experience in the direction of chemical, petroleum refining, synfuels, and environmental programs. Mr. Robert J. Davis is primarily responsible for preparation of this report. Mr. Davis has a B.A. in Geography and an M.A. in Communications. He has worked extensively in regulatory compliance areas.

Ms. Leslie E. Barras, a staff attorney with four years of multimedia environmental experience, also participated in preparing this report. Mr. Jack Burke, a chemical engineer with 14 years experience primarily in electric utility flue gas desulfurization systems, assisted in the process description and environmental and safety impact evaluation. Mr. Burke has also previously worked on technical and environmental assessments of the selective catalytic reduction process.

The following SCS and Gulf Power Company personnel provided input to this report:

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Pensacola, Florida 32520-1151
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7.0 REFERENCES AND CONTACTS

1. Literature documenting Japanese SCR experience includes a series of publications by Ando, Jumpei, et al, in the early and mid-1970s (specifically including NO_x Abatement for Stationary Sources in Japan, PEDCO, EPA Contract 68-01-4147, Task 3). Most recent summary on Japanese SCR through the mid 1980s is summarized in Ando, J. and Sedman, D., "Japanese Activities in SO_2 and NO_x Control" presented at Energy Technologies Conference, February 17-19, 1988.

2. Memoranda submitted by Gulf Power Company to Radian Corporation in 1988.

3. Applicable permits held by Plant Crist include:

   - For air, units 5 and 6: State of Florida, Department of Environmental Regulation (DER), Operating Permits. Also fugitive dust permit for operation ash storage system and silos.

   - For ground water and surface water discharges: USEPA National Pollutant Discharge Elimination System (No. FL0002275) and State of Florida, DER, (No. I017-109985).

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24. Cadle, S.H. and Mulawa, Patricia A. "Low Molecula Weight Aliphatic Amines in Exhaust from Catalyst-Equipped Cars." Environmental Science and Technology, June 1980.

25. Excerpt of a summary of EPRI-sponsored research results on EPRI project RP 3004-3, "Options for Spent SCR Catalyst," (dated December 9, 1988) provided by Gulf Power and SCS.

26. Correspondence from Mitsubishi Heavy Industries, Ltd., to Randall Rush of Southern Company Services, Inc. dated April 15, 1988.

27. Personal communication with Plant Crist Manager W.T. Lyford, February 1989.

28. Ammonia: Safe Handling Practices, EPA, IERL.

29. Personal communication with Ralph Hitchcock of LaRoche Industries, February 1989.

30. Personal communication with staff at the Bureau of Air Quality, Florida Department of Environmental Regulation, January 1989.

31. Personal communication with Gulf Power Company, August 1989.

32. Personal communication with Bryan Kerckhoff of Bureau of Air Quality, Florida Department of Environmental Regulation, August 1989.

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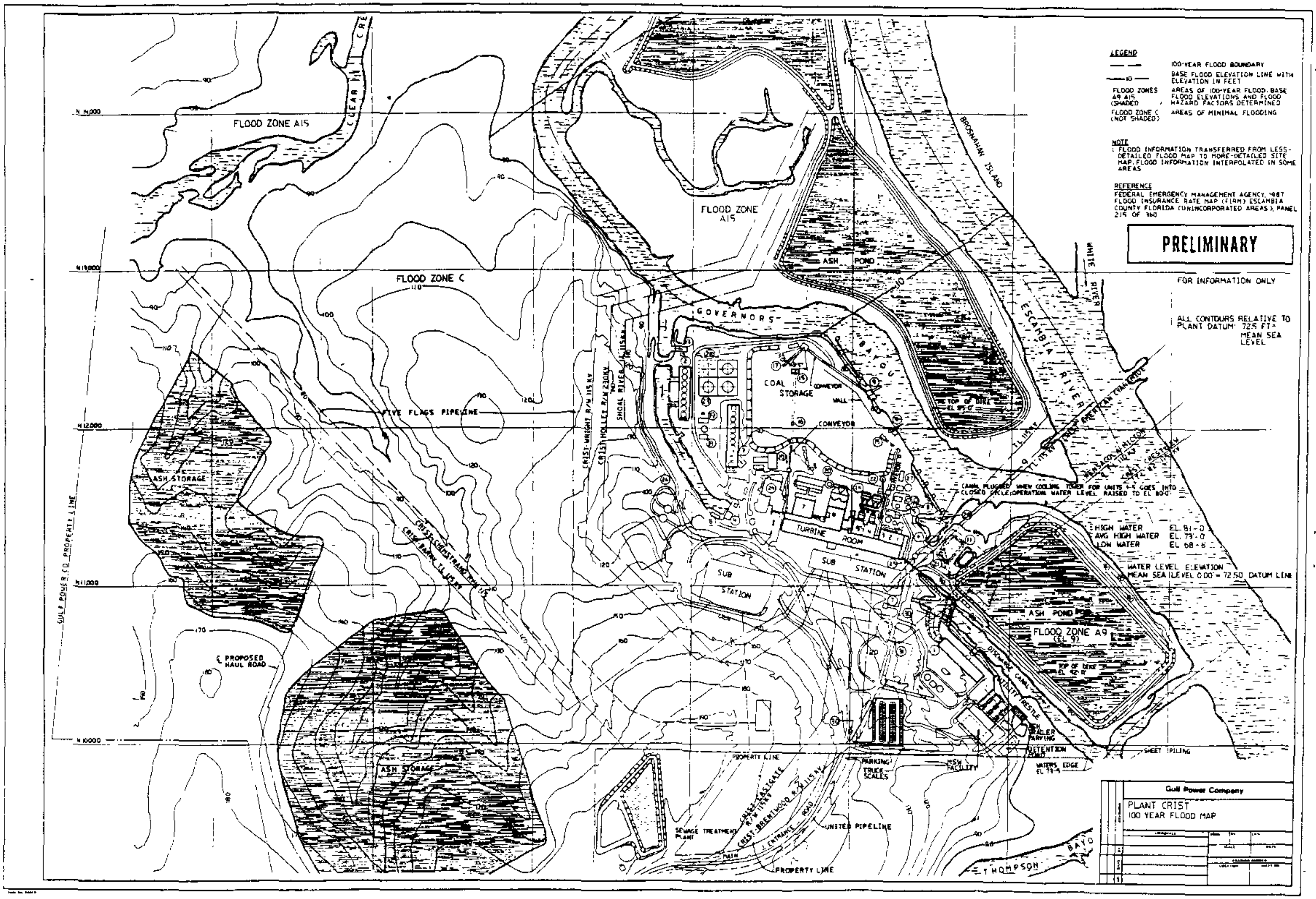
APPENDIX A



LEGEND
100-YEAR FLOOD BOUNDARY
BASE FLOOD ELEVATION LINE WITH ELEVATION IN FEET
FLOOD ZONES A9 A15 (SHADED)
AREAS OF 100-YEAR FLOOD, BASE FLOOD ELEVATIONS AND FLOOD HAZARD FACTORS DETERMINED
FLOOD ZONE C (NOT SHADED)
AREAS OF MINIMAL FLOODING
NOTE
: FLOOD INFORMATION TRANSFERRED FROM LESS-DETAILED FLOOD MAP TO MORE-DETAILED SITE MAP. FLOOD INFORMATION INTERPOLATED IN SOME AREAS
REFERENCE
FEDERAL EMERGENCY MANAGEMENT AGENCY, 1987 FLOOD INSURANCE RATE MAP (FIRM) ESCAMBIA COUNTY FLORIDA (UNINCORPORATED AREAS), PANEL 215 OF 360
PRELIMINARY
FOR INFORMATION ONLY
ALL CONTOURS RELATIVE TO PLANT DATUM: 72.5 FT = MEAN SEA LEVEL
FLOOD ZONE A15
FLOOD ZONE C
BROSNAHAN ISLAND
WHITE RIVER
ESCAMBIA RIVER
GOVERNORS BAYOU
ASH POND
TOP OF DIKE EL 85-0
COAL STORAGE
CONVEYOR
CONVEYOR WALL
FIVE FLAGS PIPELINE
CRIST-WRIGHT R/W 115 KV
CRIST-HOLLEY R/W 230 KV
SHOAL RIVER 115 KV
ASH STORAGE
GULF POWER CO. PROPERTY LINE
CRIST-LIDSTRAND R/W 115
CRIST-BARRY T.L. 115 KV
CANAL PLUGGED WHEN COOLING TOWER FOR UNITS 4-5 GOES INTO CLOSED CYCLE OPERATION. WATER LEVEL RAISED TO EL 80-0
HIGH WATER EL. 81-0
AVG HIGH WATER EL. 73-0
LOW WATER EL. 68-6
WATER LEVEL ELEVATION
MEAN SEA LEVEL 0.00 = 72.50 DATUM LINE
TURBINE ROOM
SUB STATION
SUB STATION
ASH POND
FLOOD ZONE A9 (EL 9)
TOP OF DIKE EL 42-0
DISCHARGE CANAL
UTILITY TRESTLE
TRAILER PARKING
DETENTION POND
WATERS EDGE EL 73-4
SHEET PILING
PARKING
TRUCK SCALES
MSW FACILITY
PROPERTY LINE
SEWAGE TREATMENT PLANT
CRIST-BRENTWOOD R/W 115 KV
MAIN ENTRANCE ROAD
UNITED PIPELINE
PROPERTY LINE
THOMPSON BAYOU
PROPOSED HAUL ROAD
CLEAR CREEK
N 14,000
N 13,000
N 12,000
N 11,000
N 10,000
Gulf Power Company
PLANT CRIST
100 YEAR FLOOD MAP

APPENDIX B

ROBERT G. WETHEROLD

EDUCATION:

Ph.D., Chemical Engineering, University of Texas at Austin, 1970.

M.S., Chemical Engineering, Texas A&M University, College Station, 1962.

B.S., Chemical Engineering, Texas A&I University, Kingsville, 1960.

EXPERIENCE:

Principal Engineer, Radian Corporation, Austin, TX, 1988-Present.

Senior Staff Engineer/Group Leader, Radian Corporation, Austin, TX, 1976-1987.

Senior Engineer, Radian Corporation, Austin, TX, 1975-1976.

Associate Engineer, Mobil Chemical Company, Edison, NM, 1975.

Senior Development Engineer, Mobil Chemical Company, Beaumont, TX, and Edison, NJ, 1969-1975.

Research Engineer, Chevron Research Corporation, Richmond, CA, 1962-1963, 1965.

FIELDS OF EXPERIENCE:

Dr. Wetherold is a Principal Engineer at Radian. He participates in projects involving the petroleum refining, chemical, and synthetic fuels industries. Dr. Wetherold is particularly interested in the areas of process feasibility studies, technology assessments, air pollution measurement/control, environmental monitoring, and solid waste disposal.

Dr. Wetherold is currently serving as the Project Director for the Environmental Monitoring Program for the Cool Water Coal Gasification Program (CWCGP). The CWCGP operates an integrated combined-cycle coal gasification plant in Daggett, California. Complete environmental monitoring are being performed over the initial five years of operation for this first commercial electricity-producing coal gasification plant. Dr. Wetherold's responsibilities include overall project management, process/analytical data management, emission/process data reduction and evaluation, material balance calculations to determine fates of pollutants, evaluating performance of pollution control systems in the plant, and reporting.

Dr. Wetherold is also currently serving as an in-house consultant and peer reviewer in the area of HAZOP surveys and risk assessment programs in the chemical processing industry.

Robert G. Wetherold

Dr. Wetherold was the Task Director for a recent EPA Work Assignment to assess the effectiveness of control techniques currently in use at hazardous waste treatment, storage and disposal facilities (TSDFs) to reduce volatile organic emissions to the atmosphere. A major part of this program involved the collection of field measurements of controlled and uncontrolled volatile organics emissions and control equipment operating information from operators of selected TSDFs. An aerated surface impoundment at a chemical plant and a petroleum refinery landtreatment operation were studied. The data collected at these sites are being used to determine control efficiencies, costs, and typical operating procedures of control techniques.

Dr. Wetherold was the engineering Task Director for an EPA project to measure atmospheric emissions from hazardous waste disposal facilities. A number of disposal technologies, such as landfilling, landtreatment, a surface impoundments, water treatment units, storage tanks, etc., were examined. Both vented and fugitive emissions from these sources were measured, and the results were used to evaluate existing mathematical models of these technologies. Refinements to existing models or development of new models were considered.

Dr. Wetherold recently served as Project Director in a two-phase study for the American Petroleum Institute to assess the atmospheric emissions of volatile organic compounds (VOC) from the landtreatment (landfarming) of refinery oily sludges. The effects of a number of variables on the mass and rate of fugitive VOC emissions from landfarming were determined through experimental measurements. The various parameters were correlated to the atmospheric emission rates of hydrocarbons. An empirical model was developed to relate emission rate to sludge properties and operating parameters.

Dr. Wetherold served as Task Director in an EPA program to prepare pollution control technical manuals (PCTM) for indirect coal liquefaction processes. The effort involved the development of conceptual process designs for several base case coal conversion facilities, including the design and evaluation of gas cleanup and sulfur recovery units. The various control options were evaluated and their effectiveness, efficiency, and cost were defined.

Dr. Wetherold was the Engineering Task Director for an EPA-sponsored program to measure atmospheric emissions from volatile materials which are present in or above contaminated ground waters. This work involves the development of a standard method for measuring surface emissions, measurement of emissions at selected test sites, and development of a model(s) to describe the emission phenomena.

Dr. Wetherold also served as an in-house engineering consultant in a joint government-industry project to clean up a hazardous waste disposal site on the West Coast. Site evaluation and characterization studies have been completed. A plan to clean up and reclaim this site is now being prepared. Radian will also supervise the clean-up effort.

Dr. Wetherold has had an extensive background in the measurement, evaluation, and control of VOC emissions from both point and fugitive sources. He was the

Robert G. Wetherold

Project Dirctor for a study to assess the effectiveness of maintenance practices in reducing fugitive VOC emissions from synthetic organic chemical manufacturing plants. This program involved extensive monitoring and testing in several types of organic chemical manufacturing plants (including ethylene plants). The maintenance effectiveness, leak occurrence rates, and leak recurrence rates were defined for various types of valves.

Dr. Wetherold served as Project Director in an industrial program to evaluate and recommend control processes to reduce hydrocarbon emissions from a plastics manufacturing plant. Emission sources were identified and measured to define the parameters needed in defining potential control systems. Incineration systems, solvent recovery units, and vapor recovery systems were evaluated. The technical and economic feasibilities of each were analyzed, and recommendations were made for systems to reduce emissions to several different levels.

In a study performed for the EPA, Dr. Wetherold evaluated the feasibility and cost of using carbon adsorption and incineration systems to reduce hydrocarbon emissions from auto assembly plants. The sources of these emissions were the paint spray booths and curing ovens. Conceptual designs were developed for emission control processes for both spray booths and ovens. The technical and economic feasibilities of installing, operating, and maintaining each of these control systems were evaluated. From theoretical considerations and discussions with vendors and operators, the significant design operating parameters were defined. The sensitivity of the costs to variations in these parameters was analyzed.

Dr. Wetherold served as Technical Director of a long-term EPA project to characterize the technology and assess the environmental emissions of petroleum refineries. This project involved an extensive amount of field sampling of fugitive and stack emissions. The efficiencies of various types of control technologies were evaluated through field measurements. The data base generated in this program can be used to: 1) determine the environmental impact of existing and new refineries (including health effects); 2) define the status of control technology and the needs for development of additional controls; and 3) develop emission factors suitable for use in offset analyses for non-attainment areas.

Dr. Wetherold has also participated in EPA-sponsored studies to: 1) determine the impact of proposed amendments to the Clean Air Act on the growth and expansion of the refinery and petrochemical industries; and 2) define the energy penalties incurred in petroleum refineries as a result of environmental regulations.

Dr. Wetherold has also participated in a study for ERDA to characterize waste effluents from coal conversion processes. Included was the development of a conceptual process design for an integrated Synthoil coal liquefaction plant. Heat and material balances were obtained, and the characteristics of effluent gas, water, and solid wastes were estimated.

Robert G. Wetherold

At Mobil Chemical, Dr. Wetherold was employed in the Research and Development Laboratories. He participated in the development of fixed bed catalytic processes for the isomerization of xylenes and disproportionation of toluene. Included in these studies were pilot plant startup and operation, catalyst evaluation, and economic evaluations. Two of these processes have been commercialized. In connection with these pilot plant studies, Dr. Wetherold developed computer techniques and programs for automatically controlling the pilot plants, logging the data, and performing process evaluation calculations. An IBM 1800 computer was used in these applications.

Dr. Wetherold was instrumental in the initiation and development of a superior benzene alkylation process. He was responsible for the design, construction, and startup of alkylation process pilot plants. These units included fixed bed catalytic reactors containing an exothermic gas/liquid high pressure reaction. Other duties included process evaluation studies and economic evaluations. Dr. Wetherold served as Technical Advisor for the design and operation of a commercial demonstration unit. He is a co-holder of a patent for this process (U.S. 3,751,504).

Dr. Wetherold participated in the design and construction of a semi-commercial size (150,000 lb/month) plant for the semi-batch production of a polymeric organic liquid. He was in charge of startup, process development studies, and production. Dr. Wetherold was able to improve the process by 30 percent through engineering studies and optimization of operating conditions.

Dr. Wetherold supervised the blending of oil additives packages (up to 1,000,000 lb/month). He was responsible for raw materials handling and storage, blending and equipment scheduling, process improvement, and bulk and drum shipping. He was able to significantly improve blending-cycle times and product quality.

While employed at Mobil Chemical, Dr. Wetherold also served as Production Engineer and Technical Advisor for a catalyst manufacturing plant. He was responsible for plant startup, production schedules, product quality, and process and product quality improvement studies. Dr. Wetherold was also responsible for pilot plant development of processes to manufacture crude oil additives and flame retardants.

At Chevron Research Corporation, Dr. Wetherold was assigned to the Process Design Division. In this position, he participated in the development of process designs for petrochemical and petroleum refining processes. These included hydrocracking units, hydrotreating plants, crude oil distillation columns, distillation trains, asphalt trains, and olefin units. Work included all phases of process design from conception to final report.

Dr. Wetherold also worked in process simulation while employed at Chevron. He participated in the updating and improvement of existing computer programs such as distillation column design and correlation of hydrocarbon physical and thermodynamic properties. He was a co-developer of a computer program for the design of gasoline splitters and participated in the development of a program for the design of atmospheric crude oil distillation columns.

HONORARY AND PROFESSIONAL SOCIETIES:

American Institute of Chemical Engineers, Sigma Tau, Omega Chi Epsilon.

PUBLICATIONS/REPORTS:

Wetherold, R.G., B.M. Eklund, B.L. Blaney and S.A. Thorneloe, "Assessment of Volatile Organic Emissions from a Petroleum Refinery Land Treatment Site," presented at the National Conference on Hazardous Wastes and Hazardous Materials, Atlanta, GA, March 4-6, 1986.

Wetherold, R.G., B.M. Eklund and T.P. Nelson, "A Case Study of Direct Control of Emissions from a Surface Impoundment," presented at the Eleventh Annual EPA Research Symposium (Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste), Cincinnati, OH, April 29-May 1, 1985.

Wetherold, R.G. and W.D. Balfour, "Volatile Emissions from Land Treatment Systems," presented at the Conference Land Treatment - A Hazardous Waste Management Alternative (sponsored by the University of Texas at Austin and the U.S. Environmental Protection Agency), Austin, TX, April 16-18, 1985.

Wetherold, R.G., G.E. Harris, J.I. Steinmetz, and J.W. Kamas, "Economics of Controlling Fugitive Emissions," Chemical Engineering Progress 79(11), 43, November 1983.

Weber, R.C., G.J. Langley, and R.G. Wetherold, "Reduction of Fugitive Volatile Organic Compound (VOC) Emissions by On-Line Maintenance," presented at 181st American Chemical Society National Meeting, Atlanta, GA, Division of Environmental Chemistry, March 30, 1981.

Wetherold, R.G., D.D. Rosebrook, and E.W. Cunningham, "Assessment of Hydrocarbon Emissions from Landtreatment of Oily Sludges," presented at the Seventh Annual Research Symposium, sponsored by the U.S. Environmental Protection Agency (Office of RD&D) at Philadelphia, PA, March 16-18, 1981.

Randall, J.L., R.G. Wetherold, et al., "Airborne Hydrocarbon Emissions from Landfarming of Refinery Wastes - A Laboratory Study," presented at Symposium on Fugitive Hydrocarbon Emissions at the 181st National Meeting of the American Chemical Society, Atlanta, GA, 1981.

Wetherold, R.G., R.M. Mann, et al., "Environmental Test Results for the Ruhrkohle/Ruhrchemie Coal Gasification Pilot Plant," presented at the Symposium on Environmental Aspects of Fuel Conversion Technology-VI, A Symposium on Coal-Based Synfuels, Denver, CO, October 26-30, 1981.

Provost, L.P., R.G. Wetherold, and D.D. Rosebrook, "Quality Assurance Procedures and Statistical Analysis of Fugitive Emission Data from Petroleum

Refineries," presented at conference on Quality Assurance in Air Pollution Measurement, cooperatively sponsored by the Air Pollution Association and the American Society for Quality Control, Grand Hotel, New Orleans, LA, March 11-14, 1979.

Rosebrook, D.D., R.G. Wetherold, C.D. Smith, G.E. Harris, and I.A. Jefcoat, "The Measurement of Fugitive Hydrocarbon Emissions from Selected Sources in Petroleum Refineries," presented at the 71st Annual Meeting of the Air Pollution Control Association, Houston, TX, June 1978.

Rosebrook, D.D. and R.G. Wetherold, "Fugitive Emissions - Current and Projected Studies," presented at 76th Annual Meeting of the National Petroleum Refiners Association, San Antonio, TX, March 19-21, 1978.

Rosebrook, D.D., R.G. Wetherold, and G.E. Harris, "The Assessment of Atmospheric Emissions from Petroleum Refining," presented at the Process Measurements for Environmental Assessment Symposium, New Orleans, LA, sponsored by the Environmental Protection Agency, February 1978.

Jefcoat, I.A., L. Short, R.G. Wetherold, "Fugitive Emission Control Strategies for Petroleum Refineries," presented at Refinery Emissions Symposium/Workshop, Jekyll Island, GA, sponsored by the Environmental Protection Agency, April 26-28, 1978.

Wetherold, R.G., E.H. Wissler, and K.B. Bischoff, "An Experimental and Computational Study of the Hydrolysis of Methyl Formate in a Chromatographic Reactor," Advances in Chemistry, Series 133, 1974.

Wetherold, R.G., "An Experimental and Computational Study of a Chromatographic Reactor," Ph.D. Dissertation, University of Texas at Austin, 1970.

Wetherold, R.G., "A Convergence Method (Computer) for Strippers and Absorbers," M.S. Thesis, Texas A&M University, 1962.

LESLIE ELIZABETH BARRAS

EDUCATION:

J.D., Law, The University of Texas, Austin, TX, 1984.

M.P.A., Public Affairs, The University of Texas, Austin, TX, 1984.

B.A., Political Science, Texas A&M University, College Station, TX, 1980.

EXPERIENCE:

Attorney, Environmental Analysis Department, Radian Corporation, Austin, TX, 1987-Present.

Attorney, Lloyd, Gosselink, Ryan & Fowler, P.C., Austin, TX, 1984-1987, (environmental law practice).

Law Clerk, Booth, Lloyd & Simmons P.C., Austin, TX, 1981-1984, (environmental law practice).

FIELDS OF EXPERIENCE:

Ms. Barras is familiar with the major federal and state environmental statutes relating to the regulation of hazardous waste, solid waste, water quality, air quality, and toxic substances. As an attorney in the Environmental Analysis Department, Ms. Barras' primary function is to ensure that Radian's permitting and compliance reports address applicable federal and state statutory and regulatory requirements.

Hazardous Waste Management

Ms. Barras assists Radian technical staff in helping clients resolve regulatory issues relating to hazardous waste management. She has worked with several large oil refineries on the Texas Gulf Coast on issues involving permitting exemptions and recycling matters, and has been involved in waste characterization matters with respect to a bulk liquid terminal on the Texas Gulf Coast.

Ms. Barras has also prepared and reviewed surface impoundment closure plans for a number of facilities including an Air Force base in the southwestern U.S., an oil refinery in Alaska, and a synthetic chemicals manufacturing plant in the Midwest.

Ms. Barras has further had extensive involvement in the Part B application and permitting process. She has assisted in preparing a response to a Notice of Deficiency for a major oil refinery on the Texas Gulf Coast and reviewing and preparing a response to the draft permit provisions of another refinery in the same locale. She is directly responsible for preparing the general facility management portions, including the training plan and contingency plan, for a proposed commercial hazardous waste incinerator facility in East Texas.

Regulatory Compliance Planning

Ms. Barras undertook primary responsibility for preparation of a regulatory compliance plan for the two Texas sites proposed for location of the Superconducting Super Collider; one of the sites was selected as the candidate locale by the U.S. Department of Energy in November 1988. This task involved several months of intensive research on applicable local, state, and federal requirements as well as numerous contacts with regulatory officials.

More recently, Ms. Barras has completed a regulatory compliance assessment for a national pharmaceuticals company which is relocating an eye care product formulation plant from California to a central Texas location. In addition, to enable a central Texas lime plant to understand the regulatory implications of burning hazardous waste-derived fuels for energy recovery, Ms. Barras developed a detailed environmental compliance document. She is also undertaking ongoing environmental compliance forecasting and planning for two petrochemical plants, one on the Texas Gulf Coast and the other on the Louisiana Gulf Coast.

Environmental/Regulatory Compliance Auditing

With the increased concern of parties to real estate transactions about environmental liability implications, Radian has been extensively involved in site investigations and assessments. Ms. Barras has participated in transactions involving a waste reclamation facility, a cogeneration facility, and a petrochemical plant on the Texas Gulf Coast, a warehouse facility in the Dallas-Fort Worth area, and a commercial office building in central Texas. She has also undertaken an environmental audit of a cement manufacturing facility in north-central Texas.

Ms. Barras has also participated in intensive environmental compliance evaluations for a number of U.S. Air Force Strategic Air Command Bases in Texas. These evaluations involve intensive, one-week assessments of Base compliance in a number of media areas, such as pesticides, waste, air, water, hazardous materials, and polychlorinated biphenyls.

Prior Work Experience

In private practice, Ms. Barras represented individuals, private and public corporations, and municipalities in securing water quality and hazardous waste permits from the Texas Water Commission. Clients included a national commercial hazardous waste management firm, a specialty steel plant, a recreation lodge, and an agricultural concern. She also provided legal input into preparation of applications for these permits and worked with both the legal and technical staffs of the Commission during their review of the applications. Solid waste permitting by the Texas Department of Health for municipal clients is another area in which Ms. Barras served as counsel for municipal applicants. Ms. Barras also had extensive experience in reviewing draft permits for regulatory and legal sufficiency and operational feasibility and negotiated permit conditions with the legal and technical staffs of several regulatory agencies.

The expansion of administrative enforcement powers of the environmental agencies of the State of Texas as well as the federal Environmental Protection Agency provided Ms. Barras further opportunities for environmental counsel. She has negotiated and participated in drafting administrative orders that imposed remediation requirements and monetary penalties on wastewater treatment facilities and hazardous waste management facilities.

The range of her representation of clients in enforcement matters during private practice varied from resolving alleged water quality violations at a vegetable processing plant to alleged hazardous waste violations at creosoting, electroplating, and oil field service facilities. Ms. Barras also participated in resolving administrative enforcement actions brought by the Texas Air Control Board against a number of industrial clients.

PROFESSIONAL SOCIETIES:

State Bar of Texas, Natural Resources and Environmental Law Section

PUBLICATIONS:

Bell, R. and L. Barras. "On-Site Versus Off-Site Incineration to Remediate a Surface Impoundment." Presented at International Conference on Incineration of Hazardous, Radioactive, and Mixed Wastes, University of California at Irvine, May 3-6, 1988.

ROBERT J. DAVIS

EDUCATION:

M.A., Communications (Journalism), The University of Texas at Austin, 1971.

B.A., Geography, The University of Texas at Austin, 1968.

EXPERIENCE:

Senior Scientist, Environmental Analysis Department, Radian Corporation, Austin, TX, 1987-Present.

Group Leader, Regulatory and Environmental Analysis Department, Radian Corporation, Research Triangle Park, NC, 1984-1987.

Group Leader, Policy Analysis Department, Radian Corporation, Austin, TX, 1979-1984.

Various administrative and technical positions, Radian Corporation, Austin, TX, 1977-1979.

Staff Member, Texas Governor's Energy Advisory Council, Austin, TX, 1974-1977.

Planner, City of Amarillo, TX, 1972-1974.

Reporter, Amarillo Globe News, 1971-1972.

FIELDS OF EXPERIENCE:

Mr. Davis has participated in and served as project director on a variety of Radian contracts requiring coordination of interdisciplinary skills, or involving one or more of the following: regulatory and environmental analysis, development of air pollution standards and enforcement techniques, and public information and communication skills.

Regulatory and Environmental Analysis

- Directed the development of a multidisciplinary environmental assessment of a proposed petrochemical plant in South Texas.

- Task Leader on U.S. Department of Energy (DOE) strategic planning effort to examine alternative means of environmental regulation. Involved development of innovative regulatory approaches such as economic incentives and cross media controls.

Robert J. Davis

- Directed a segment of the U.S. Environmental Protection Agency's (EPA) "Six Month Study" of the toxic air pollutant problem in the U.S.

- Directed a project for the American Petroleum Institute examining the problem of temperature compensation in the marketing of petroleum products--including the impact of state regulations.

- Task Leader on policy issues associated with the development of Texas lignite, a major program conducted for the State of Texas. Also participated in a similar project for the State of Mississippi.

- Task Leader evaluating policy issues and problems associated with the importation of Western coal to California (under contract to the California Energy Commission).

- Task Leader (soils, land use, and geology) for the environmental assessment of the Texas site for the proposed Superconducting Super Collider.

- Directed a project for the American Gas Association evaluating the contribution of natural gas transmission facilities to the acid rain problem and the impact of various proposed legislation on the gas industry.

- Directed a project for the U.S. DOE examining the impacts of Clean Air Act construction bans and federal funding restrictions on the several hundred areas if the nation subject to these bans.

- Participated in a strategic planning project for a private client who is affected by future of federal, state, and local environmental regulations.

- Directed a project for the U.S. DOE evaluating the impact of the Toxic Substances Control Act on the future of the synthetic fuel industry.

- Under contract to DOE, directed a Congressionally mandated study evaluating the socio-economic impacts of electric utility outages (blackouts) and how to minimize these impacts.

- Directed a program evaluating the future research and development needs for the state of Texas in the area of air pollution control.

Robert J. Davis

Standards Development and Enforcement

- Directed three-year project assisting EPA in the development of a national air pollution standard controlling woodstove emissions. This involved participation in the first major standard to be developed through the process of regulatory negotiation, technical evaluation of control techniques, and assessment of policy and enforcement options.

- Directed a project for the enforcement branch of EPA in which Radian developed techniques for implementing and enforcing the woodstoves air pollution standard.

- Wrote the regulation and preambles for air pollution standards for arsenic emitting glass manufacturing plants and for hydrocarbon emitting reactor processes at synthetic organic chemical manufacturing plants.

- Directed and participated in several projects related to the implementation and enforcement of regulations controlling emissions from automobiles. These clients included individual states as well as EPA's mobile source control program.

Public Information and Communication Skills

- Directed the technology transfer and public information (e.g., press releases, pamphlets, brochures, slide show, etc.) tasks for Radian's DOE-funded geothermal demonstration project involving the retrofit from natural gas to geothermal heating for a north Texas hospital.

- Designed, wrote, and edited several in-house brochures and a nationally distributed brochure for the general public on the selection of woodstoves and how to improve heating efficiencies.

- Wrote and assisted in the development of several Federal Register announcements, EPA position papers and other materials designed for informing and influencing the general public.

- Participated as an instructor in a three-day toxic air pollution control seminar for state and local air pollution control personnel in the Mountain and Pacific Coast states.

APPENDIX C

Attached are copies of the computer runs conducted by Southern Company Services for Plant Crist using the EP's Industrial Source Complex Long-Term Model (ISCLTM). Two cases were modeled. The first case modeled is the change in maximum NO_2 emissions resulting from the use of SCR on Unit 5; the second case modeled is the change in maximum NO_2 emissions resulting from the use of SCR on Unit 6.

The receptors used for input into the ISCLTM was a square grid 36 kilometers on a side with the plant located in the center. Each receptor was located at plant elevation reflecting the flat terrain surrounding the plant.

Plant Crist

SO2

Long-Term

ISCLT Model

Case 1

FILE: CRIST FILE A SOUTHERN COMPANY SERVICES - BIRMINGHAM

ISCLT (VERSION 82341)
AN AIR QUALITY DISPERSION MODEL IN
SECTION 2. NON-GUIDELINE MODELS.
IN UNAMAP (VERSION 5) DEC 82.
SOURCE: FILE 19 ON UNAMAP MAGNETIC TAPE FROM NTIS.

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**** ISCLT ************* PLANT CRIST - CASE 1                                        ******** PAGE      1 ****

                                   - ISCLT INPUT DATA -

         NUMBER OF SOURCES =    1
         NUMBER OF X AXIS GRID SYSTEM POINTS =   19
         NUMBER OF Y AXIS GRID SYSTEM POINTS =   19
         NUMBER OF SPECIAL POINTS =    0
         NUMBER OF SEASONS =    1
         NUMBER OF WIND SPEED CLASSES =   6
         NUMBER OF STABILITY CLASSES =   6
         NUMBER OF WIND DIRECTION CLASSES =  16
         FILE NUMBER OF DATA FILE USED FOR REPORTS =    1
         THE PROGRAM IS RUN IN RURAL MODE
         CONCENTRATION (DEPOSITION) UNITS CONVERSION FACTOR =0.10000000E+07
         ACCELERATION OF GRAVITY (METERS/SEC**2) =  9.800
         HEIGHT OF MEASUREMENT OF WIND SPEED (METERS) =  10.000
         ENTRAINMENT PARAMETER FOR UNSTABLE CONDITIONS = 0.600
         ENTRAINMENT PARAMETER FOR STABLE CONDITIONS = 0.600
         CORRECTION ANGLE FOR GRID SYSTEM VERSUS DIRECTION DATA NORTH (DEGREES) =   0.000
         DECAY COEFFICIENT =0.00000000E+00
         PROGRAM OPTION SWITCHES = 1, 1, 1, 0, 0, 3, 2, 1, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
        DISTANCE X AXIS GRID SYSTEM POINTS (METERS )=  -18000.00,  -16000.00,  -14000.00,  -12000.00,  -10000.00,   -8000.00,
            -6000.00,   -4000.00,   -2000.00,       0.00,    2000.00,    4000.00,    6000.00,    8000.00,   10000.00,   12000.00,
            14000.00,   16000.00,   18000.00,
        DISTANCE Y AXIS GRID SYSTEM POINTS (METERS )=  -18000.00,  -16000.00,  -14000.00,  -12000.00,  -10000.00,   -8000.00,
            -6000.00,   -4000.00,   -2000.00,       0.00,    2000.00,    4000.00,    6000.00,    8000.00,   10000.00,   12000.00,
            14000.00,   16000.00,   18000.00,

                        - AMBIENT AIR TEMPERATURE (DEGREES KELVIN) -

                   STABILITY  STABILITY  STABILITY  STABILITY  STABILITY  STABILITY
                   CATEGORY 1 CATEGORY 2 CATEGORY 3 CATEGORY 4 CATEGORY 5 CATEGORY 6
         SEASON  1   293.3701   293.3701   293.3701   293.3701   293.3701   293.3701

                              - MIXING LAYER HEIGHT (METERS) -

                                           SEASON 1
                      WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED
                      CATEGORY 1  CATEGORY 2  CATEGORY 3  CATEGORY 4  CATEGORY 5  CATEGORY 6
STABILITY CATEGORY 10.115000E+040.115000E+040.115000E+040.115000E+040.115000E+040.115000E+04
STABILITY CATEGORY 20.115000E+040.115000E+040.115000E+040.115000E+040.115000E+040.115000E+04
STABILITY CATEGORY 30.115000E+040.115000E+040.115000E+040.115000E+040.115000E+040.115000E+04
STABILITY CATEGORY 40.115000E+040.115000E+040.115000E+040.115000E+040.115000E+040.115000E+04
STABILITY CATEGORY 50.100000E+050.100000E+050.100000E+050.100000E+050.100000E+050.100000E+05
STABILITY CATEGORY 60.100000E+050.100000E+050.100000E+050.100000E+050.100000E+050.100000E+05
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- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 1

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00023000	0.00021000	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00001000	0.00002000	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00003000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00007000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00014000	0.00002000	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00008000	0.00009000	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00012000	0.00018000	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00010000	0.00014000	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00036000	0.00034000	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00007000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00009000	0.00005000	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00001000	0.00002000	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00011000	0.00009000	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00007000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00005000	0.00005000	0.00000000	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 2

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00128998	0.00179998	0.00054999	0.00000000	0.00000000	0.00000000
22.500	0.00066999	0.00086999	0.00037000	0.00000000	0.00000000	0.00000000
45.000	0.00056999	0.00090999	0.00011000	0.00000000	0.00000000	0.00000000
67.500	0.00096999	0.00131998	0.00034000	0.00000000	0.00000000	0.00000000
90.000	0.00115999	0.00239997	0.00113999	0.00000000	0.00000000	0.00000000
112.500	0.00068999	0.00191998	0.00138998	0.00000000	0.00000000	0.00000000
135.000	0.00080999	0.00262997	0.00250997	0.00000000	0.00000000	0.00000000
157.500	0.00133998	0.00330996	0.00373995	0.00000000	0.00000000	0.00000000
180.000	0.00144998	0.00451994	0.00574993	0.00000000	0.00000000	0.00000000
202.500	0.00050999	0.00077999	0.00102999	0.00000000	0.00000000	0.00000000
225.000	0.00012000	0.00032000	0.00054999	0.00000000	0.00000000	0.00000000
247.500	0.00026000	0.00023000	0.00011000	0.00000000	0.00000000	0.00000000
270.000	0.00037000	0.00040999	0.00023000	0.00000000	0.00000000	0.00000000
292.500	0.00038000	0.00061999	0.00016000	0.00000000	0.00000000	0.00000000
315.000	0.00038000	0.00099999	0.00037000	0.00000000	0.00000000	0.00000000
337.500	0.00057999	0.00138998	0.00052999	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 3

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00082999	0.00207997	0.00499994	0.00061999	0.00005000	0.00000000
22.500	0.00048999	0.00136998	0.00284996	0.00030000	0.00005000	0.00000000
45.000	0.00039999	0.00152998	0.00184998	0.00011000	0.00000000	0.00000000
67.500	0.00043999	0.00182998	0.00357996	0.00021000	0.00000000	0.00000000
90.000	0.00053999	0.00220997	0.00627992	0.00081999	0.00000000	0.00000000
112.500	0.00050999	0.00175998	0.00919988	0.00168998	0.00005000	0.00002000
135.000	0.00060999	0.00239997	0.00784990	0.00166998	0.00000000	0.00000000
157.500	0.00077999	0.00284996	0.00823990	0.00122998	0.00002000	0.00000000
180.000	0.00088999	0.00472994	0.01440982	0.00271997	0.00000000	0.00002000
202.500	0.00053999	0.00182998	0.00718991	0.00451994	0.00016000	0.00000000
225.000	0.00023000	0.00122998	0.00488994	0.00405995	0.00102999	0.00009000
247.500	0.00019000	0.00093999	0.00252997	0.00088999	0.00042999	0.00009000
270.000	0.00037000	0.00081999	0.00182998	0.00045999	0.00016000	0.00002000
292.500	0.00022000	0.00063999	0.00173998	0.00021000	0.00000000	0.00000000
315.000	0.00045999	0.00067999	0.00227997	0.00027000	0.00005000	0.00000000
337.500	0.00050999	0.00170998	0.00449995	0.00049999	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 4

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00158998	0.00472994	0.01499981	0.01951976	0.00383995	0.00052999
22.500	0.00083999	0.00330996	0.00732991	0.00784990	0.00081999	0.00005000
45.000	0.00072999	0.00230997	0.00716991	0.00691991	0.00074999	0.00016000
67.500	0.00104999	0.00341996	0.01031987	0.01024987	0.00102999	0.00007000
90.000	0.00167998	0.00545993	0.01823977	0.01974975	0.00200997	0.00021000
112.500	0.00119999	0.00403995	0.01259984	0.01410982	0.00127998	0.00023000
135.000	0.00084999	0.00341996	0.01056987	0.01079987	0.00097999	0.00049999
157.500	0.00094999	0.00401995	0.01161985	0.00947988	0.00086999	0.00023000
180.000	0.00128998	0.00447994	0.01604980	0.01549981	0.00202997	0.00106999
202.500	0.00067999	0.00284996	0.00860989	0.00924988	0.00106999	0.00021000
225.000	0.00040999	0.00204997	0.00855989	0.01275984	0.00168998	0.00016000
247.500	0.00059999	0.00168998	0.00805990	0.00892989	0.00175998	0.00030000
270.000	0.00086999	0.00257997	0.00869989	0.00718991	0.00145998	0.00034000
292.500	0.00054999	0.00168998	0.00478994	0.00442994	0.00109999	0.00021000
315.000	0.00090999	0.00239997	0.00478994	0.00828990	0.00184998	0.00067999
337.500	0.00111999	0.00362995	0.00864989	0.01152986	0.00330996	0.00049999

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 5

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00000000	0.00842989	0.01451982	0.00000000	0.00000000	0.00000000
22.500	0.00000000	0.00483994	0.00545993	0.00000000	0.00000000	0.00000000
45.000	0.00000000	0.00417995	0.00558993	0.00000000	0.00000000	0.00000000
67.500	0.00000000	0.00344996	0.00492994	0.00000000	0.00000000	0.00000000
90.000	0.00000000	0.00453994	0.00597993	0.00000000	0.00000000	0.00000000
112.500	0.00000000	0.00257997	0.00170998	0.00000000	0.00000000	0.00000000
135.000	0.00000000	0.00312996	0.00216997	0.00000000	0.00000000	0.00000000
157.500	0.00000000	0.00321996	0.00296996	0.00000000	0.00000000	0.00000000
180.000	0.00000000	0.00451994	0.00488994	0.00000000	0.00000000	0.00000000
202.500	0.00000000	0.00291996	0.00337996	0.00000000	0.00000000	0.00000000
225.000	0.00000000	0.00252997	0.00346996	0.00000000	0.00000000	0.00000000
247.500	0.00000000	0.00312996	0.00554993	0.00000000	0.00000000	0.00000000
270.000	0.00000000	0.00536993	0.00622992	0.00000000	0.00000000	0.00000000
292.500	0.00000000	0.00294996	0.00330996	0.00000000	0.00000000	0.00000000
315.000	0.00000000	0.00303996	0.00412995	0.00000000	0.00000000	0.00000000
337.500	0.00000000	0.00367995	0.00613992	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 6

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.02116974	0.02380970	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.01053987	0.01399982	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00745991	0.01118986	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00401995	0.00565993	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00441995	0.00476994	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00230997	0.00204997	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00269997	0.00268997	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00342996	0.00360996	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00412995	0.00483994	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00240997	0.00314996	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00255997	0.00284996	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00346996	0.00494994	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00782990	0.01079987	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00690991	0.00654992	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00712991	0.00752990	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00975988	0.01083986	0.00000000	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- VERTICAL POTENTIAL TEMPERATURE GRADIENT (DEGREES KELVIN/METER) -

```
                            WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED
                            CATEGORY 1  CATEGORY 2  CATEGORY 3  CATEGORY 4  CATEGORY 5  CATEGORY 6
STABILITY CATEGORY 10.000000E+000.000000E+000.000000E+000.000000E+000.000000E+000.000000E+00
STABILITY CATEGORY 20.000000E+000.000000E+000.000000E+000.000000E+000.000000E+000.000000E+00
STABILITY CATEGORY 30.000000E+000.000000E+000.000000E+000.000000E+000.000000E+000.000000E+00
STABILITY CATEGORY 40.000000E+000.000000E+000.000000E+000.000000E+000.000000E+000.000000E+00
STABILITY CATEGORY 50.200000E-010.200000E-010.200000E-010.200000E-010.200000E-010.200000E-01
STABILITY CATEGORY 60.350000E-010.350000E-010.350000E-010.350000E-010.350000E-010.350000E-01
```

- WIND PROFILE POWER LAW EXPONENTS -

```
                            WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED
                            CATEGORY 1  CATEGORY 2  CATEGORY 3  CATEGORY 4  CATEGORY 5  CATEGORY 6
STABILITY CATEGORY 10.100000E+000.100000E+000.100000E+000.100000E+000.100000E+000.100000E+00
STABILITY CATEGORY 20.150000E+000.150000E+000.150000E+000.150000E+000.150000E+000.150000E+00
STABILITY CATEGORY 30.200000E+000.200000E+000.200000E+000.200000E+000.200000E+000.200000E+00
STABILITY CATEGORY 40.250000E+000.250000E+000.250000E+000.250000E+000.250000E+000.250000E+00
STABILITY CATEGORY 50.300000E+000.300000E+000.300000E+000.300000E+000.300000E+000.300000E+00
STABILITY CATEGORY 60.300000E+000.300000E+000.300000E+000.300000E+000.300000E+000.300000E+00
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                                      - SOURCE INPUT DATA -

C T SOURCE SOURCE     X           Y       EMISSION  BASE /
A A NUMBER  TYPE  COORDINATE  COORDINATE   HEIGHT  ELEV- /               - SOURCE DETAILS DEPENDING ON TYPE -
R P                   (M)         (M)        (M)    ATION /
D E                                                  (M)  /
------------------------------------------------------------------------------------------------------------------------
X        1  STACK    478.60     3381.30  130.53    0.00 GAS EXIT TEMP (DEG K)= 415.90, GAS EXIT VEL. (M/SEC)= 16.00,
                                                        STACK DIAMETER (M)= 5.490, HEIGHT OF ASSO. BLDG. (M)=  0.00, WIDTH OF
                                                        ASSO. BLDG. (M)=   0.00, WAKE EFFECTS FLAG = 0
                                                              - SOURCE STRENGTHS ( GRAMS PER SEC                    ) -
                                                                    SEASON 1      SEASON 2      SEASON 3      SEASON 4
                                                                  -5.00000E+00
```

** ANNUAL GROUND LEVEL CONCENTRATION (MICROGRAMS PER CUBIC METER) DUE TO SOURCE 1 **

- GRID SYSTEM RECEPTORS -
- X AXIS (DISTANCE, METERS) -

Y AXIS (DISTANCE, METERS)	-18000.000	-16000.000	-14000.000	-12000.000	-10000.000	-8000.000	-6000.000	-4000.000	-2000.000
	- CONCENTRATION -								
18000.000	-0.004173	-0.004332	-0.004502	-0.004739	-0.004993	-0.005269	-0.005568	-0.006506	-0.007730
16000.000	-0.004376	-0.004557	-0.004739	-0.004936	-0.005221	-0.005540	-0.005896	-0.006659	-0.008205
14000.000	-0.004589	-0.004792	-0.004999	-0.005220	-0.005472	-0.005843	-0.006273	-0.006764	-0.008719
12000.000	-0.004811	-0.005040	-0.005280	-0.005540	-0.005830	-0.006182	-0.006707	-0.007329	-0.009170
10000.000	-0.005141	-0.005323	-0.005583	-0.005891	-0.006238	-0.006651	-0.007174	-0.007958	-0.009424
8000.000	-0.005590	-0.005804	-0.006035	-0.006305	-0.006680	-0.007158	-0.007739	-0.008693	-0.010329
6000.000	-0.006063	-0.006323	-0.006593	-0.006879	-0.007209	-0.007601	-0.008326	-0.009395	-0.010909
4000.000	-0.006540	-0.006855	-0.007177	-0.007498	-0.007813	-0.008031	-0.008267	-0.008751	-0.007196
2000.000	-0.006113	-0.006337	-0.006537	-0.006691	-0.006762	-0.006619	-0.006239	-0.005481	-0.003231
0.000	-0.005297	-0.005379	-0.005401	-0.005334	-0.005138	-0.004729	-0.004287	-0.003567	-0.003097
-2000.000	-0.004531	-0.004499	-0.004393	-0.004242	-0.004135	-0.003897	-0.003449	-0.003186	-0.003568
-4000.000	-0.003841	-0.003831	-0.003819	-0.003746	-0.003593	-0.003343	-0.003201	-0.003359	-0.004217
-6000.000	-0.003489	-0.003494	-0.003452	-0.003356	-0.003198	-0.003124	-0.003251	-0.003467	-0.004868
-8000.000	-0.003217	-0.003209	-0.003153	-0.003055	-0.003021	-0.003126	-0.003275	-0.003629	-0.005259
-10000.000	-0.002978	-0.002960	-0.002910	-0.002904	-0.003002	-0.003122	-0.003278	-0.004032	-0.005470
-12000.000	-0.002769	-0.002745	-0.002769	-0.002872	-0.002979	-0.003106	-0.003261	-0.004308	-0.005568
-14000.000	-0.002588	-0.002619	-0.002720	-0.002829	-0.002949	-0.003076	-0.003491	-0.004481	-0.005585
-16000.000	-0.002477	-0.002570	-0.002670	-0.002778	-0.002895	-0.003023	-0.003682	-0.004577	-0.005546
-18000.000	-0.002431	-0.002522	-0.002619	-0.002722	-0.002834	-0.003059	-0.003790	-0.004593	-0.005446

- GRID SYSTEM RECEPTORS -
- X AXIS (DISTANCE, METERS) -

Y AXIS (DISTANCE, METERS)	0.000	2000.000	4000.000	6000.000	8000.000	10000.000	12000.000	14000.000	16000.000
	- CONCENTRATION -								
18000.000	-0.009009	-0.008003	-0.006306	-0.004757	-0.004243	-0.004074	-0.003918	-0.003771	-0.003555
16000.000	-0.009862	-0.008571	-0.006415	-0.004737	-0.004498	-0.004295	-0.004115	-0.003857	-0.003543
14000.000	-0.010955	-0.009230	-0.006400	-0.005086	-0.004779	-0.004533	-0.004194	-0.003793	-0.003483
12000.000	-0.012330	-0.009903	-0.006087	-0.005468	-0.005071	-0.004585	-0.004048	-0.003665	-0.003378
10000.000	-0.014216	-0.010504	-0.006554	-0.005775	-0.005035	-0.004276	-0.003794	-0.003467	-0.003226
8000.000	-0.016761	-0.010326	-0.006909	-0.005426	-0.004324	-0.003769	-0.003448	-0.003307	-0.003191
6000.000	-0.015185	-0.007723	-0.005545	-0.003798	-0.003430	-0.003381	-0.003317	-0.003251	-0.003182
4000.000	-0.000323	-0.000712	-0.002588	-0.002882	-0.003047	-0.003185	-0.003233	-0.003228	-0.003193
2000.000	-0.000653	-0.001714	-0.002241	-0.002410	-0.002593	-0.002772	-0.002870	-0.002913	-0.002920
0.000	-0.005265	-0.005300	-0.003251	-0.002627	-0.002308	-0.002323	-0.002418	-0.002489	-0.002531
-2000.000	-0.006397	-0.006048	-0.004436	-0.003246	-0.002780	-0.002466	-0.002240	-0.002132	-0.002188
-4000.000	-0.006851	-0.006373	-0.005133	-0.003948	-0.003171	-0.002775	-0.002487	-0.002272	-0.002105
-6000.000	-0.007113	-0.006608	-0.005431	-0.004399	-0.003589	-0.003009	-0.002692	-0.002446	-0.002250
-8000.000	-0.007150	-0.006670	-0.005539	-0.004623	-0.003880	-0.003292	-0.002844	-0.002583	-0.002371
-10000.000	-0.007064	-0.006625	-0.005599	-0.004716	-0.004054	-0.003499	-0.003045	-0.002682	-0.002461
-12000.000	-0.006924	-0.006527	-0.005608	-0.004781	-0.004141	-0.003632	-0.003197	-0.002827	-0.002514
-14000.000	-0.006749	-0.006392	-0.005573	-0.004813	-0.004164	-0.003704	-0.003293	-0.002931	-0.002618
-16000.000	-0.006553	-0.006233	-0.005504	-0.004812	-0.004175	-0.003716	-0.003336	-0.002997	-0.002697
-18000.000	-0.006319	-0.006035	-0.005387	-0.004760	-0.004173	-0.003690	-0.003346	-0.003031	-0.002748

** ANNUAL GROUND LEVEL CONCENTRATION (MICROGRAMS PER CUBIC METER) DUE TO SOURCE 1 (CONT.) **

- GRID SYSTEM RECEPTORS -

- X AXIS (DISTANCE, METERS) -

Y AXIS (DISTANCE , METERS)	18000.000
	- CONCENTRATION -
18000.000	-0.003293
16000.000	-0.003279
14000.000	-0.003233
12000.000	-0.003150
10000.000	-0.003077
8000.000	-0.003087
6000.000	-0.003106
4000.000	-0.003137
2000.000	-0.002899
0.000	-0.002547
-2000.000	-0.002226
-4000.000	-0.001970
-6000.000	-0.002090
-8000.000	-0.002192
-10000.000	-0.002268
-12000.000	-0.002321
-14000.000	-0.002354
-16000.000	-0.002433
-18000.000	-0.002495

Plant Crist

SO2

Long-Term

ISCLT Model

Case 2

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****************************************** END OF ISCLT PROGRAM,     1 SOURCES PROCESSED *****************************************
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ISCLT (VERSION 82341)
AN AIR QUALITY DISPERSION MODEL IN
SECTION 2. NON-GUIDELINE MODELS.
IN UNAMAP (VERSION 5) DEC 82.
SOURCE: FILE 19 ON UNAMAP MAGNETIC TAPE FROM NTIS.

```
                         - ISCLT INPUT DATA -

   NUMBER OF SOURCES =    1
   NUMBER OF X AXIS GRID SYSTEM POINTS =    19
   NUMBER OF Y AXIS GRID SYSTEM POINTS =    19
   NUMBER OF SPECIAL POINTS =     0
   NUMBER OF SEASONS =    1
   NUMBER OF WIND SPEED CLASSES =   6
   NUMBER OF STABILITY CLASSES =   6
   NUMBER OF WIND DIRECTION CLASSES =  16
   FILE NUMBER OF DATA FILE USED FOR REPORTS =    1
   THE PROGRAM IS RUN IN RURAL MODE
   CONCENTRATION (DEPOSITION) UNITS CONVERSION FACTOR =0.10000000E+07
   ACCELERATION OF GRAVITY (METERS/SEC**2) =  9.800
   HEIGHT OF MEASUREMENT OF WIND SPEED (METERS) =  10.000
   ENTRAINMENT PARAMETER FOR UNSTABLE CONDITIONS = 0.600
   ENTRAINMENT PARAMETER FOR STABLE CONDITIONS = 0.600
   CORRECTION ANGLE FOR GRID SYSTEM VERSUS DIRECTION DATA NORTH (DEGREES) =   0.000
   DECAY COEFFICIENT =0.00000000E+00
   PROGRAM OPTION SWITCHES = 1, 1, 1, 0, 0, 3, 2, 1, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  DISTANCE X AXIS GRID SYSTEM POINTS (METERS )=  -18000.00,  -16000.00,  -14000.00,  -12000.00,  -10000.00,   -8000.00,
      -6000.00,   -4000.00,   -2000.00,       0.00,    2000.00,    4000.00,    6000.00,    8000.00,   10000.00,   12000.00,
      14000.00,   16000.00,   18000.00,
  DISTANCE Y AXIS GRID SYSTEM POINTS (METERS )=  -18000.00,  -16000.00,  -14000.00,  -12000.00,  -10000.00,   -8000.00,
      -6000.00,   -4000.00,   -2000.00,       0.00,    2000.00,    4000.00,    6000.00,    8000.00,   10000.00,   12000.00,
      14000.00,   16000.00,   18000.00,

                  - AMBIENT AIR TEMPERATURE (DEGREES KELVIN) -

              STABILITY  STABILITY  STABILITY  STABILITY  STABILITY  STABILITY
              CATEGORY 1 CATEGORY 2 CATEGORY 3 CATEGORY 4 CATEGORY 5 CATEGORY 6
   SEASON  1   293.3701   293.3701   293.3701   293.3701   293.3701   293.3701

                     - MIXING LAYER HEIGHT (METERS) -

                                   SEASON 1
                 WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED
                 CATEGORY 1  CATEGORY 2  CATEGORY 3  CATEGORY 4  CATEGORY 5  CATEGORY 6
STABILITY CATEGORY 10.115000E+040.115000E+040.115000E+040.115000E+040.115000E+040.115000E+04
STABILITY CATEGORY 20.115000E+040.115000E+040.115000E+040.115000E+040.115000E+040.115000E+04
STABILITY CATEGORY 30.115000E+040.115000E+040.115000E+040.115000E+040.115000E+040.115000E+04
STABILITY CATEGORY 40.115000E+040.115000E+040.115000E+040.115000E+040.115000E+040.115000E+04
STABILITY CATEGORY 50.100000E+050.100000E+050.100000E+050.100000E+050.100000E+050.100000E+05
STABILITY CATEGORY 60.100000E+050.100000E+050.100000E+050.100000E+050.100000E+050.100000E+05
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- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 1

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00023000	0.00021000	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00001000	0.00002000	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00003000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00007000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00014000	0.00002000	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00008000	0.00009000	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00012000	0.00018000	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00010000	0.00014000	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00036000	0.00034000	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00007000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00009000	0.00005000	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00001000	0.00002000	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00011000	0.00009000	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00007000	0.00007000	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00005000	0.00005000	0.00000000	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 2

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00128998	0.00179998	0.00054999	0.00000000	0.00000000	0.00000000
22.500	0.00066999	0.00086999	0.00037000	0.00000000	0.00000000	0.00000000
45.000	0.00056999	0.00090999	0.00011000	0.00000000	0.00000000	0.00000000
67.500	0.00096999	0.00131998	0.00034000	0.00000000	0.00000000	0.00000000
90.000	0.00115999	0.00239997	0.00113999	0.00000000	0.00000000	0.00000000
112.500	0.00068999	0.00191998	0.00138998	0.00000000	0.00000000	0.00000000
135.000	0.00080999	0.00262997	0.00250997	0.00000000	0.00000000	0.00000000
157.500	0.00133998	0.00330996	0.00373995	0.00000000	0.00000000	0.00000000
180.000	0.00144998	0.00451994	0.00574993	0.00000000	0.00000000	0.00000000
202.500	0.00050999	0.00077999	0.00102999	0.00000000	0.00000000	0.00000000
225.000	0.00012000	0.00032000	0.00054999	0.00000000	0.00000000	0.00000000
247.500	0.00026000	0.00023000	0.00011000	0.00000000	0.00000000	0.00000000
270.000	0.00037000	0.00040999	0.00023000	0.00000000	0.00000000	0.00000000
292.500	0.00038000	0.00061999	0.00016000	0.00000000	0.00000000	0.00000000
315.000	0.00038000	0.00099999	0.00037000	0.00000000	0.00000000	0.00000000
337.500	0.00057999	0.00138998	0.00052999	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 3

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00082999	0.00207997	0.00499994	0.00061999	0.00005000	0.00000000
22.500	0.00048999	0.00136998	0.00284996	0.00030000	0.00005000	0.00000000
45.000	0.00039999	0.00152998	0.00184998	0.00011000	0.00000000	0.00000000
67.500	0.00043999	0.00182998	0.00357996	0.00021000	0.00000000	0.00000000
90.000	0.00053999	0.00220997	0.00627992	0.00081999	0.00000000	0.00000000
112.500	0.00050999	0.00175998	0.00919988	0.00168998	0.00005000	0.00002000
135.000	0.00060999	0.00239997	0.00784990	0.00166998	0.00000000	0.00000000
157.500	0.00077999	0.00284996	0.00823990	0.00122998	0.00002000	0.00000000
180.000	0.00088999	0.00472994	0.01440982	0.00271997	0.00000000	0.00002000
202.500	0.00053999	0.00182998	0.00718991	0.00451994	0.00016000	0.00000000
225.000	0.00023000	0.00122998	0.00488994	0.00405995	0.00102999	0.00009000
247.500	0.00019000	0.00093999	0.00252997	0.00088999	0.00042999	0.00009000
270.000	0.00037000	0.00081999	0.00182998	0.00045999	0.00016000	0.00002000
292.500	0.00022000	0.00083999	0.00173998	0.00021000	0.00000000	0.00000000
315.000	0.00045999	0.00087999	0.00227997	0.00027000	0.00005000	0.00000000
337.500	0.00050999	0.00170998	0.00449995	0.00049999	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 4

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00158998	0.00472994	0.01499981	0.01951976	0.00383995	0.00052999
22.500	0.00083999	0.00330996	0.00732991	0.00784990	0.00081999	0.00005000
45.000	0.00072999	0.00230997	0.00716991	0.00691991	0.00074999	0.00016000
67.500	0.00104999	0.00341996	0.01031987	0.01024987	0.00102999	0.00007000
90.000	0.00167998	0.00545993	0.01823977	0.01974975	0.00200997	0.00021000
112.500	0.00119999	0.00403995	0.01259984	0.01410982	0.00127998	0.00023000
135.000	0.00084999	0.00341996	0.01056987	0.01079987	0.00097999	0.00049999
157.500	0.00094999	0.00401995	0.01161985	0.00947988	0.00086999	0.00023000
180.000	0.00128998	0.00447994	0.01604980	0.01549981	0.00202997	0.00106999
202.500	0.00067999	0.00284996	0.00860989	0.00924988	0.00106999	0.00021000
225.000	0.00040999	0.00204997	0.00855989	0.01275984	0.00168998	0.00016000
247.500	0.00059999	0.00168998	0.00805990	0.00892989	0.00175998	0.00030000
270.000	0.00086999	0.00257997	0.00869989	0.00718991	0.00145998	0.00034000
292.500	0.00054999	0.00168998	0.00478994	0.00442994	0.00109999	0.00021000
315.000	0.00090999	0.00239997	0.00478994	0.00828990	0.00184998	0.00067999
337.500	0.00111999	0.00362995	0.00864989	0.01152986	0.00330996	0.00049999

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 5

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00000000	0.00842989	0.01451982	0.00000000	0.00000000	0.00000000
22.500	0.00000000	0.00483994	0.00545993	0.00000000	0.00000000	0.00000000
45.000	0.00000000	0.00417995	0.00558993	0.00000000	0.00000000	0.00000000
67.500	0.00000000	0.00344996	0.00492994	0.00000000	0.00000000	0.00000000
90.000	0.00000000	0.00453994	0.00597993	0.00000000	0.00000000	0.00000000
112.500	0.00000000	0.00257997	0.00170998	0.00000000	0.00000000	0.00000000
135.000	0.00000000	0.00312996	0.00216997	0.00000000	0.00000000	0.00000000
157.500	0.00000000	0.00321996	0.00296996	0.00000000	0.00000000	0.00000000
180.000	0.00000000	0.00451994	0.00488994	0.00000000	0.00000000	0.00000000
202.500	0.00000000	0.00291996	0.00337996	0.00000000	0.00000000	0.00000000
225.000	0.00000000	0.00252997	0.00346996	0.00000000	0.00000000	0.00000000
247.500	0.00000000	0.00312996	0.00554993	0.00000000	0.00000000	0.00000000
270.000	0.00000000	0.00536993	0.00622992	0.00000000	0.00000000	0.00000000
292.500	0.00000000	0.00294996	0.00330996	0.00000000	0.00000000	0.00000000
315.000	0.00000000	0.00303996	0.00412995	0.00000000	0.00000000	0.00000000
337.500	0.00000000	0.00367995	0.00613992	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 6

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 (0.7500MPS)	WIND SPEED CATEGORY 2 (2.5000MPS)	WIND SPEED CATEGORY 3 (4.3000MPS)	WIND SPEED CATEGORY 4 (6.8000MPS)	WIND SPEED CATEGORY 5 (9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.02116974	0.02380970	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.01053987	0.01399982	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00745991	0.01118986	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00401995	0.00565993	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00441995	0.00476994	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00230997	0.00204997	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00269997	0.00268997	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00342996	0.00360996	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00412995	0.00483994	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00240997	0.00314996	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00255997	0.00294996	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00346996	0.00494994	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00762990	0.01079987	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00690991	0.00654992	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00712991	0.00752990	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00975988	0.01083986	0.00000000	0.00000000	0.00000000	0.00000000

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**** ISCLT ************* PLANT CRIST - CASE 2                                                              ******** PAGE     5 ****

                                             - ISCLT INPUT DATA (CONT.) -

                                - VERTICAL POTENTIAL TEMPERATURE GRADIENT (DEGREES KELVIN/METER) -

                      WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED
                      CATEGORY 1  CATEGORY 2  CATEGORY 3  CATEGORY 4  CATEGORY 5  CATEGORY 6
STABILITY CATEGORY 10.000000E+000.000000E+000.000000E+000.000000E+000.000000E+000.000000E+00
STABILITY CATEGORY 20.000000E+000.000000E+000.000000E+000.000000E+000.000000E+000.000000E+00
STABILITY CATEGORY 30.000000E+000.000000E+000.000000E+000.000000E+000.000000E+000.000000E+00
STABILITY CATEGORY 40.000000E+000.000000E+000.000000E+000.000000E+000.000000E+000.000000E+00
STABILITY CATEGORY 50.200000E-010.200000E-010.200000E-010.200000E-010.200000E-010.200000E-01
STABILITY CATEGORY 60.350000E-010.350000E-010.350000E-010.350000E-010.350000E-010.350000E-01

                                             - WIND PROFILE POWER LAW EXPONENTS -

                      WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED  WIND SPEED
                      CATEGORY 1  CATEGORY 2  CATEGORY 3  CATEGORY 4  CATEGORY 5  CATEGORY 6
STABILITY CATEGORY 10.100000E+000.100000E+000.100000E+000.100000E+000.100000E+000.100000E+00
STABILITY CATEGORY 20.150000E+000.150000E+000.150000E+000.150000E+000.150000E+000.150000E+00
STABILITY CATEGORY 30.200000E+000.200000E+000.200000E+000.200000E+000.200000E+000.200000E+00
STABILITY CATEGORY 40.250000E+000.250000E+000.250000E+000.250000E+000.250000E+000.250000E+00
STABILITY CATEGORY 50.300000E+000.300000E+000.300000E+000.300000E+000.300000E+000.300000E+00
STABILITY CATEGORY 60.300000E+000.300000E+000.300000E+000.300000E+000.300000E+000.300000E+00
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                                         - SOURCE INPUT DATA -

C T SOURCE SOURCE      X          Y       EMISSION  BASE /
A A NUMBER  TYPE  COORDINATE  COORDINATE  HEIGHT  ELEV- /                 - SOURCE DETAILS DEPENDING ON TYPE -
R P                   (M)         (M)       (M)   ATION /
D E                                                (M)  /
-----------------------------------------------------------------------------------------------------------------------
X        1  STACK     478.50     3381.30 137.16    0.00 GAS EXIT TEMP (DEG K)= 404.30, GAS EXIT VEL. (M/SEC)= 29.69,
                                                        STACK DIAMETER (M)= 7.060, HEIGHT OF ASSO. BLDG. (M)=  0.00, WIDTH OF
                                                        ASSO. BLDG. (M)=   0.00, WAKE EFFECTS FLAG = 0
                                                             - SOURCE STRENGTHS ( GRAMS PER SEC                    ) -
                                                                  SEASON 1      SEASON 2      SEASON 3      SEASON 4
                                                                -1.23000E+01
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** ANNUAL GROUND LEVEL CONCENTRATION (MICROGRAMS PER CUBIC METER) DUE TO SOURCE 1 **

- GRID SYSTEM RECEPTORS -
- X AXIS (DISTANCE, METERS) -
- CONCENTRATION -

Y AXIS (DISTANCE, METERS)	-18000.000	-16000.000	-14000.000	-12000.000	-10000.000	-8000.000	-6000.000	-4000.000	-2000.000
18000.000	-0.006036	-0.006234	-0.006465	-0.006732	-0.007044	-0.007417	-0.007858	-0.009266	-0.011123
16000.000	-0.006185	-0.006387	-0.006620	-0.006908	-0.007255	-0.007689	-0.008222	-0.009382	-0.011691
14000.000	-0.006339	-0.006542	-0.006780	-0.007085	-0.007487	-0.008003	-0.008666	-0.009477	-0.012355
12000.000	-0.006500	-0.006704	-0.006952	-0.007279	-0.007729	-0.008353	-0.009180	-0.010221	-0.012925
10000.000	-0.006698	-0.006879	-0.007135	-0.007486	-0.007987	-0.008705	-0.009678	-0.010878	-0.012870
8000.000	-0.006957	-0.007097	-0.007308	-0.007662	-0.008239	-0.009004	-0.009963	-0.011083	-0.012037
6000.000	-0.007257	-0.007364	-0.007514	-0.007768	-0.008225	-0.008953	-0.009982	-0.009937	-0.008628
4000.000	-0.007588	-0.007668	-0.007759	-0.007902	-0.008157	-0.008497	-0.008727	-0.007563	-0.002711
2000.000	-0.007017	-0.006997	-0.006953	-0.006903	-0.006864	-0.006742	-0.006275	-0.004541	-0.001296
0.000	-0.006077	-0.005940	-0.005753	-0.005514	-0.005214	-0.004765	-0.004241	-0.003157	-0.002177
-2000.000	-0.005226	-0.005009	-0.004731	-0.004429	-0.004186	-0.003852	-0.003329	-0.003014	-0.003383
-4000.000	-0.004494	-0.004323	-0.004143	-0.003910	-0.003619	-0.003259	-0.003078	-0.003311	-0.004171
-6000.000	-0.004106	-0.003962	-0.003767	-0.003525	-0.003238	-0.003081	-0.003199	-0.003457	-0.004744
-8000.000	-0.003811	-0.003672	-0.003481	-0.003257	-0.003123	-0.003171	-0.003301	-0.003655	-0.005154
-10000.000	-0.003563	-0.003434	-0.003272	-0.003168	-0.003192	-0.003263	-0.003400	-0.004116	-0.005498
-12000.000	-0.003356	-0.003239	-0.003180	-0.003215	-0.003263	-0.003351	-0.003492	-0.004526	-0.005802
-14000.000	-0.003184	-0.003147	-0.003191	-0.003249	-0.003327	-0.003428	-0.003844	-0.004877	-0.006058
-16000.000	-0.003095	-0.003143	-0.003200	-0.003271	-0.003361	-0.003476	-0.004182	-0.005168	-0.006259
-18000.000	-0.003082	-0.003139	-0.003205	-0.003284	-0.003379	-0.003818	-0.004443	-0.005371	-0.006376

- GRID SYSTEM RECEPTORS -
- X AXIS (DISTANCE, METERS) -
- CONCENTRATION -

Y AXIS (DISTANCE, METERS)	0.000	2000.000	4000.000	6000.000	8000.000	10000.000	12000.000	14000.000	16000.000
18000.000	-0.013083	-0.011473	-0.008803	-0.006392	-0.005543	-0.005257	-0.005049	-0.004898	-0.004657
16000.000	-0.014173	-0.012133	-0.008781	-0.006168	-0.005691	-0.005349	-0.005116	-0.004814	-0.004436
14000.000	-0.015832	-0.012934	-0.008587	-0.006456	-0.005839	-0.005422	-0.004979	-0.004491	-0.004146
12000.000	-0.017397	-0.013669	-0.007939	-0.006736	-0.005945	-0.005215	-0.004525	-0.004082	-0.003797
10000.000	-0.018875	-0.013604	-0.008186	-0.006822	-0.005609	-0.004548	-0.003933	-0.003589	-0.003397
8000.000	-0.017620	-0.010706	-0.007724	-0.006021	-0.004435	-0.003610	-0.003235	-0.003194	-0.003195
6000.000	-0.008467	-0.004441	-0.004994	-0.003527	-0.003066	-0.002995	-0.002970	-0.002997	-0.003054
4000.000	-0.000016	-0.000201	-0.001583	-0.002434	-0.002635	-0.002707	-0.002777	-0.002868	-0.002970
2000.000	-0.000300	-0.000622	-0.001583	-0.002229	-0.002407	-0.002476	-0.002550	-0.002647	-0.002757
0.000	-0.003105	-0.003402	-0.002987	-0.002688	-0.002395	-0.002306	-0.002331	-0.002404	-0.002500
-2000.000	-0.005710	-0.005599	-0.004466	-0.003379	-0.002889	-0.002550	-0.002322	-0.002226	-0.002295
-4000.000	-0.006515	-0.006293	-0.005396	-0.004150	-0.003332	-0.002932	-0.002649	-0.002455	-0.002321
-6000.000	-0.006769	-0.006509	-0.005735	-0.004713	-0.003857	-0.003273	-0.002963	-0.002731	-0.002556
-8000.000	-0.006917	-0.006635	-0.005831	-0.005083	-0.004288	-0.003681	-0.003240	-0.002985	-0.002781
-10000.000	-0.007059	-0.006764	-0.005971	-0.005344	-0.004625	-0.004033	-0.003564	-0.003205	-0.002980
-12000.000	-0.007205	-0.006904	-0.006131	-0.005481	-0.004882	-0.004319	-0.003849	-0.003461	-0.003139
-14000.000	-0.007328	-0.007029	-0.006282	-0.005627	-0.005072	-0.004543	-0.004080	-0.003678	-0.003336
-16000.000	-0.007415	-0.007123	-0.006408	-0.005761	-0.005192	-0.004694	-0.004247	-0.003853	-0.003509
-18000.000	-0.007424	-0.007146	-0.006472	-0.005843	-0.005277	-0.004790	-0.004369	-0.003989	-0.003651

** ANNUAL GROUND LEVEL CONCENTRATION (MICROGRAMS PER CUBIC METER) DUE TO SOURCE 1 (CONT.) **

- GRID SYSTEM RECEPTORS -

- X AXIS (DISTANCE, METERS) -

Y AXIS (DISTANCE , METERS)	18000.000
	- CONCENTRATION -
18000.000	-0.004335
16000.000	-0.004138
14000.000	-0.003895
12000.000	-0.003606
10000.000	-0.003345
8000.000	-0.003214
6000.000	-0.003118
4000.000	-0.003067
2000.000	-0.002862
0.000	-0.002599
-2000.000	-0.002378
-4000.000	-0.002226
-6000.000	-0.002424
-8000.000	-0.002616
-10000.000	-0.002786
-12000.000	-0.002932
-14000.000	-0.003051
-16000.000	-0.003211
-18000.000	-0.003352